Sutarto Hadi

# MEMBUKUKAN ARTIKEL AKADEMIS

Editor :
Ersis Warmansyah Abbas

PROGRAM STUDI PENDIDIKAN IPS
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN
UNIVERSITAS LAMBUNG MANGKURAT
BANJARMASIN
2022

Sutarto Hadi MEMBUKUKAN ARTIKEL AKADEMIS

**Sutarto Hadi**

# Membukukan Artikel Akademis

Editor :
Ersis Warmansyah Abbas
2022

Penulis : Sutarto Hadi
Setting/Layout : Ersis Warmansyah Abbas
Desain Sampul : Ersis Warmansyah Abbas
Pemeriksa Aksara : Risna Warnidah
Cetakan Pertama : April 2022

Editor :
Ersis Warmansyah Abbas

Diterbitkan oleh:
Program Studi Pendidikan Ilmu Pengetahuan Sosial
Jurusan Pendidikan Ilmu Pengetahuan Sosial
Fakultas Keguruan dan Ilmu Pendidikan
Universitas Lambung Mangkurat
Banjarmasin

ISBN 978-623-99984-1-7

Sutarto Hadi

# Membukukan Artikel Akademis

**Sanksi Pelanggaran Pasal 72:**
Undang-Undang Nomor 19 Tahun 2002
tentang Perubahan atas Undang-Undang Nomor 12 Tahun 1997
tentang Hak Cipta

1. Barang siapa dengan sengaja dan tanpa hak mengumumkan atau memperbanyak suatu ciptaan atau memberi izin untuk itu, dipidana dengan pidana penjara masing-masing paling singkat 1 (satu bulan dan/atau dengan paling sedikit Rp1.000.000.00 (satu juta rupiah) atau pidana penjara paling lama 7 (tujuh) tahun dan/atau denda paling banyak Rp.5.000.000.000,00 (lima miliar rupiah).

2. Barang siapa dengan sengaja menyiarkan, memamerkan, mengedarkan, atau menjual kepada umum suatu ciptaan atau barang hasil pelanggaran Hak Cipta sebagaimana dimaksud dalam ayat (1), dipidana dengan pidana penjara paling lama 5 (lima) tahun dan/ atau dengan paling banyak Rp500.000.000,00 (lima ratus juta rupiah).

# Sambutan

Ersis Warmansyah Abbas
Editor dan Koordinator Program Studi Pendidikan IPS FKIP ULM

Assalamualaikum warahmatullahi wabarakatuh

Kumpulan tulisan Prof. Sutarto Hadi, *Membukukan Artikel Jurnal*, berawal dari hal sederhana. Sejak dua tahun lalu, setelah melalui berbagai pelatihan, dosen-dosen muda Program Studi Pendidikan IPS FKIP ULM, menulis lebih intensif artikel akademis untuk dipresentasi di berbagai seminar dan konferensi, dan atau, dipublikasi di jurnal ilmiah. Program tersebut menjadi penanda pasti gerak publikasi karya ilmiah. Lalu kenapa?

Mutiani, dosen Pendidikan IPS FKIP ULM, baru berstatus ASN, tahun 2021, menulis 21 artikel dan Jumriani, tahun 2021, menulis 23 artikel dan artikel Muhammad Adhitya Hidayat Putra, Muhammad Rezky Noor Handy dan Rusmaniah tidak mengecewakan. Muhammad Ridha, baru dinyatakan lulus seleksi dosen ULM, diikutkan penelitian dan pengabdian masyarakat dan menulis beberapa artikel. Saya tidak mengingat keberatan atau protes mereka dipaksa menulis. Motivasi ganas saya, dosen tanpa karya, dosa he he.

Kumpulan artikel mereka saya *setting* dan *layout*, tanpa sepengetahuan mereka. Saya kerjakan sendiri. Saya dedikasikan sebagai apresiasi atas kerelaan mereka "dipaksa" menulis. Setelah menjadi *dummy*, setiap orang diminta memeriksa karya masing-masing. Giliran mereka kaget.

Lalu, apa hubungannya dengan Prof. Sutarto Hadi? Bukankah Prof. Sutarto Hadi dari Pendidikan Matematika FKIP ULM? Itu dia. Prof. Sutarto, Rektor ULM, "milik" semua program studi dan Insan ULM. Prodi Pendidikan IPS FKIP ULM disuport dan diapresiasi untuk banyak hal. Terbetik ide membukukan artikel Prof. Sutarto Hadi. Kerjakan. Jadilah buku *Membukukan Artikel Jurnal*

Ya, bersama buku *Membukukan Artikel Jurnal* diterbitkan 10 (sepuluh) buku oleh penerbit Pendidikan IPS FKIP ULM. Program Studi Pendidikan IPS FKIP ULM sebagai penerbit? Ya. Kami telah mendapatkan lebih 50 ISBN (*International Standard Book Number*) dari Perpustakaan Nasional Indonesia. Alhamdulillah.

Untuk itu, kepada Prof. Sutarto Hadi, mohon maaf atas kelancangan ini. Seperti juga kepada anak-anak muda tersebut, buku *Membukukan Artikel Jurnal* merupakan apresiasi kepada Prof. Sutarto Hadi. Mohon maaf atas kekurangan di sana-sini. Semangat menulis dan membukukan tulisan menjadi ghirah menggebu yang mudahan ke depan naik level berbasis kualitas.

Salam maaf. Aamiin Ya Rabbal Alamin.

Banjarbaru, 21 April 2022

**Prof. Dr. Drs. Ersis Warmansyah Abbas, BA, M.Pd.**

# Pengantar Penulis

Sutarto Hadi

Bismillahirrahmanirrahim.

Buku *Membukukan Artikel Akademis* dapat dikatakan buku kagetan dan mengagetkan sebagai kumpulan tulisan (artikel) yang pada awalnya saya tidak tahu-menahu. Prof. Ersis Warmansyah Abbas, menyampaikan *dummy* buku tersebut kepada saya, tanpa pembicaraan terlebih dahulu akan membukukan tulisan-tulisan saya. Saya membaca isinya, terlepas dari kekurangan, bagus saja dibukukan. Apalagi, telah siap cetak.

Sebagai pribadi dan sebagai Rektor ULM, saya mengapresiasi "kecanduan" Prof. Ersis menulis, dari menulis hal-hal sederhana sampai menulis karya ilmiah. Ketika "kecanduan" tersebut ditularkan, baik melalui motivasi, sharing atau pelatihan, bahkan membukukan karya, tentu dengan maksud agar jangkauan "kecanduan menulis" menjangkiti sebanyak mungkin orang, terutama bagi insan akademis.

Seingat saya, gaya Prof. Ersis adalah, membicarakan hal-hal hulu, misalnya tentang membaca sampai keterampilan menulis yang kemudian bermuara kepada publikasi tulisan. Dalam pergaulan pribadi kami, kami banyak membicarakan pikiran para penulis hebat dunia, dari Socrates sampai Francis Fukiyama dalam pandangan ke kinian untuk menatap ke depan. Sekalipun disiplin saya pendidikan matematika, kami mendiskusikan muatan historis kehidupan manusia. Pada tataran tersebut, Prof. Ersis biasa masuk dengan kampanye : "Menulis sebagai aktivitas mengukir sejarah".

Saya sependapat, apa-apa yang kita pelajari, kita alami, kita pikirkan, dan bahkan kita impikan, sebaiknya ditulis. Menulis sebagai keterampilan adalah pembiasaan. Pembiasaan bukan saja menuntut pengetahuan, sebab pembiasaan adalah akumulasi aplikasi diri secara kontinu, setahap demi setahap, tiada henti. Menulis sebagai kebiasaan semogalah menjadi *life style*.

Sekalipun seharusnya ada beberapa hal yang harus disempurnakan pada buku *Membukukan Artikel Akademis* ini, saya menyetujui untuk diterbitkan. Sebab, kekurangan di sana-sini bukanlah hal fatal. Pilihan Prof. Ersis sebagai editor adalah haknya.

Salam menulis, salam membukukan tulisan.

Banjarmasin, 21 April 2022

**Prof. Dr. Sutarto Hadi, M.Si., M.Sc**

# DAFTAR ISI

# 1. Education in Disruption 4.0 Era Development of Work Culture in Elementary School at Banjarmasin South Kalimantan Indonesia

Ahmad Suriansyah, Sutarto Hadi,
Aminuddin Prahatama Putera, Aslamiah
Lambung Mangkurat University, Indonesia.

**ABSTRACT**

This study was aimed to analyze the model of the work culture in elementary schools. This study used the qualitative approach using the case study type. The research instruments were researchers themselves. The data were collected using an in-depth interview, participation observation, and documentation. The respondents were selected using the snowball sampling technique. The data were analyzed using the model developed by Creswell. The verification of the data was done through credibility, transferability, dependability, and confirmability criteria. The findings showed that the model for the development of work culture in elementary school start from the vision, mission, norm and value, strategies of the schools, quality and equity. In the process development of the commitment, competency, autonomy, empowering and continues improving the teachers, internal and external monitoring and external standard of quality work.

Key Words: Work culture, elementary school, education, qualitative approach

## I. INTRODUCTION

Now everyone is surprised and get busy by the arrival of a new era which known as the industrial revolution 4.0 era or also known as by the name disruption era. Industrial revolution 4.0 era requires human resources who are

intelligent and characteristic to master the ability to face tough challenges and completions regionally and globally. This is the reason why the current and future Indonesia human resources must have the characteristic (performance characteristic: hard work, disciplined, resilient, not easy to give up, complete and has the characteristic of moral values such as faith and piety, honest, humble, polite/ morals), competency (creative thinking, creativity, communication, collaboration and problem-solving), literacy (reading and writing, numeracy, scientific literacy, ICT Fluency/technology skills), language skill, cultural awareness, logical thinking) and the ability to communicate within the global world. Facing this challenge, Indonesia is demanded to produce human resources with the best quality. This process is done by establishing the best quality of education from early childhood education (PAUD) until higher education.

The world now is currently facing industrial revolution 4.0 or which known as Industrial 4.0. According to Mckinsey Global Institute's analysis, Industrial 4.0 is giving great and wide impact especially on the employment sector, in which robot and machine have replaced a lot of employment opportunities in the world. For this reason, the industrial revolution 4.0 has to be addressed wisely and carefully. This industrial era, with its connectives and digitalization, can increase the efficiency of the manufacturing chain and product quality. On the other hand, this industry is going to vanish 800 million employment opportunity in the whole world by 2030 because it will be taken over by robots. This can be a threat to Indonesia as a country who has quite high labour force and unemployment rate. This is the reason why the government need to address this change correctly through developing strategies that can increase the competitiveness of national industries while creating wider employment.

By observing various changes and innovations as well as the existing developments, the Government of Indonesia is currently implementing strategic steps which determined based on the Making Indonesia 4.0 road map. This effort was made to accelerate the realization of the national vision that has been decided to take advantage of the opportunities in the industrial revolution 4.0 era, which is to get Indonesia into the top 10 countries that have the strongest economy in the world in 2030 (Satya, 2018).

Quality becomes Indonesia citizens' hope and attention and becomes very urgent and strategic because the quality of education in various types and levels of education is still a problem and does not meet the expectations of all parties. Even though UU Sisdiknas Bab XIV, article 51 has stated that "Management of higher education units is carried out based

on the principles of autonomy, accountability, quality assurance and transparent evaluation" (UU No: 20), as also strengthened Peraturan Pemerintah Nomor, Bab XV, article 91 section 1 that "Every education unit in the formal and non-formal channels is required to carry out education quality assurance" (PP No: 19). Furthermore, it is emphasized through article 91 section 3 that "Quality assurance of education must be carried out in stages, systematically and planned in a quality assurance program that has a clear target and time frame" (PP No: 19).

The education nationally still faced to complex issues, incomplete equal distribution issues in education and the lows of the relevance of education with the social requirement as yet faced further with life issues. There are poor quality results of educations. According to data 2017, the ranking of Indonesia stands on rank 5 in ASEAN (other issues is the character of the student such as student scuffle, drugs, teacher beating by student and vice versa, immoral violation, even the most common is glueing in the elementary school. Moreover, it is currently becoming one of the quality indicators of low graduation rate in CPNS (Candidates for civil servant) participant selection in various type/sector occupations joined. It causes concern in society.

Many factors become the reasons for poor quality education even very complex, such as human resources (quantity and quality), sources of funds, supporting facilities for education and learning culture, and work culture as well as various other factors including educational policies and the community environment. One of the factors that have not become a concern or has not been formed from the elements of education providers up to the school level is a quality-oriented work culture (quality culture).

Known by many people in the business world and has succeeded in making progress for them it seems like it has not affected the world of education as a whole and comprehensively. Minister of research, technology, and education Mohamad Nasir explained, based on earlier evaluation of the country's readiness in facing the industrial revolution 4.0 Indonesia was expected as a country with high potential (Rohida, 2018). Although, Indonesia is still below from Singapore, at the level of Southeast Asia Indonesia's position is quite calculated. While related to the Global competitiveness index in World Economic Forum 2017-2018, Indonesia ranked 36$^{th}$, up by five ranks from the previous year 41$^{st}$ position out of 137 countries (Mukhlasin, 2019).

## II. LITERATURE REVIEW

Quality improvement in an educational institution environment at any type and level is strongly influenced by work habits, work culture and organizational culture that are interrelated. Without a work culture and quality work culture, quality improvement will not be achieved as desired and become a demand of the community (Memon, Soomro, & Kumar, 2018; Suriansyah, 2010, 2017). The efforts to improve quality can be done by improving the quality of the education process at the school level. One thing which is very urgent but often forgotten is the management organization model in improving the quality of the process is the implementation of Total Quality Management (TQM).

Implementation of TQM seeks to ensure that all members of the organization can create, innovate and excel in activities that become their respective duties and responsibilities, by involving, empowering, giving recognition and appreciation to all people fairly and equally (equity and equality). To improve the achievements of organizational members, staff must be involved and provide for their needs. Therefore coaching and training, understanding of the vision, mission and goals and strategies of all people in their work, as well as giving recognition of their contributions to improving organizational performance becomes a very important, fundamental and strategic thing.

Research that has been done on organizations including educational organizations generally agrees that the need to change organizational culture requires the implementation of Total Quality Management (TQM) as an approach to organizational management (Adebanjo & Kehoe 1999; Ahmed, 1999; Chen, Kang, & Guo, 2020; Kanji & Yui, 1997; Manley, 1998; Vermeulen, 1977). Ciampa (1991) has also suggested that organizational culture can be strongly altered through continuous improvement programs, which are the implementation of important elements in TQM. However, in its implementation, this change cannot occur in a short time. Organizational culture is not something that is created by a leader alone or something that can be escorted and predicted by members of the organization. Quality organizational culture is something that is assembled and formed and is the result of everyone in the organization, so cultural change is far from impossible, even though quality work culture is a slow and difficult process to achieve maximum change in a short time. This means that changes in work culture can be done through a process that is consistent and continuously carried out by the leadership.

Since more than a century ago, the study of organizational culture has become a special attraction for experts, especially in the context of understanding and practising organizational behaviour as a quality work culture. Schein (2004) suggests that organizational culture includes two dimensions, namely (1) Dimensions of external environments; in which there are five namely: (a) mission and strategy; (b) goals; (c) means to achieve goals; (d) measurement; and (e) correction, and (2) The dimensions of internal integration in which there are six main aspects, namely: (a) common language; (b) group boundaries for inclusion and exclusion; (c) distributing power and status; (d) developing norms of intimacy, friendship, and love; (e) reward and punishment; and (f) explaining and explainable: ideology and religion.

The quality of work is very closely related to the work culture that is owned and underlying the people in carrying out activities related to their daily tasks and functions. The common thing is that educators and education staff are often bound by habits without any willingness to change the work process with new things as a result of creativity and innovation, while quality will not succeed without a quality process. A quality process is something that must be formed through quality work habits. To reach the stage of quality work habits must start from the leadership of educational institutions to the lowest level, namely students (Altarash, 2018; Suriansyah, 2010, 2017).

Various studies proved that the formation of quality work culture can be done by Implementing Total Quality Management (TQM) or widely known as Integrated Quality Management. This model leads to changes in traditional work culture towards more focus on quality work culture, therefore, it is very strategic if implemented in the world of education from Pre-school to University. A touch of TQM will be able to grow a quality work culture and a quality education process which in term will produce quality products.

Implementation of integrated quality management in the performance and management of the educational institution, in general, is focusing on cultural development and work quality from each person in the organization. This is important because quality development can be achieved with improving the activities and the process of the activities. The problem is that how high-quality culture can be invented in the implementation of education until the school level.

## III. METHODS

This study used the qualitative approach and multi-case study. The research instrument of this research is the researchers themselves. The data were collected using the in-depth interview, participation observation and documentation. The Key information of the research is Principals, supervisor, parent, community leaders and board of education. The respondents were selected using a snowball sampling technique. Key informants who participated in this study consisted of school principals, deputy principals, teachers, community leaders, education offices from superior and outstanding elementary schools in Banjarmasin and alumni from the school. The data verification is done through credibility, transformability, dependability and confirmability criteria. The data analyzed using the model developed by Creswell.

## IV. RESULTS AND DISCUSSION

Based on the results of the analysis of interview, observation and documentation data obtained the description of the quality work culture is strongly influenced by several factors that are interconnected, mutually influencing and mutually reinforcing namely: the vision, mission, norm and value, strategies of the school and quality and equity. In the process development of the commitment, competency, autonomy, empowering and continues improving the teachers, internal and external monitoring and external standard of quality work. Based on the findings above, the model of improving the quality of work culture can be formulated as follows.


Figure 1: The quality of work culture

4.1. Vision, mission and basic values in quality work culture

From various research results, there is a similarity that changing organizational culture is a necessary condition for the successful implementation of Total Quality Management (TQM) towards a quality work culture (Adebanjo & Kehoem, 1999; Ahmed et al., 1999; Kanji & Yui, 1997; Manley, 1998; Vermeulen, 1997; Ciampa, 1991) and (Owlia & Aspinwall, 1997) Penn State University (Zairi, Ahmed, Ali & Bomatia, 2007). Changes in work behaviour and culture must begin by establishing a vision, mission, characteristics, behavioural values and values work culture that is clear and understood by all people (members of the organization), therefore intensive, comprehensive and continuous socialization is accompanied by an evaluation of its understanding by all members of the organization because values, vision and mission are basic values for the creation of a quality work culture from an organization (Wilkinson & Dale, 2001). Strong belief in the value system will be the basis and make it easier to solve word problems. Therefore, without a strong understanding and belief by staff towards values, vision and mission, the involvement and sense of ownership of the institution will be weak which can result in performance at work.

Building commitment towards value, vision, and mission is done through socialization and the most important is through the excellent examples from parts of all of the educational institution leader in forms of speech, action, and behaviour towards daily activities. The study that has been done by the experts has proved the important role of leader as a strong commitment model in the implementation of duty and is quality-oriented (speech, action, and performance) will bring a big impact towards the commitment of the staffs. (Lee et al., 1999; Rivers & Bae, 1999; Cummings & Worley, 2001; Powel, 1995; Aly & Akpoi, 2001). Therefore, the equality of chief and teachers, educational staffs along with stakeholders proceeding to the institution is one of the elements of the determinant of a successful forming of qualified work ethic. The achievements of a school in creating innovation and program in spect enhancement are influenced by the ability of the headmaster in changing the behaviour, manner, and actions of educators in everyday activity (Hoy & Miskel, 2013).

4.2. The continues and programmed improvement of competence

From many studies discovered that organization, in this case, is a part of educational institution needing competent improvement effort and be done continuously along with the advancement of education and technology with the

public's demands. Those things mentioned has also been declared by many results that affirm the improvement of competence is a major need to shape skilful work tendency and ethic. Sallis (1995) stated that Total Quality Management (TQM) can be understood as continuous refinement philosophy before the organization's goal which can be achieved by the participation of all components in said organization. This proves that the continues improvement of competitiveness is the most important element in the application of competent work ethic as been said by Cruickshank (2003) and Zairi et al. (2007). The training of scholars and educational staffs becomes strategic as an endeavour to enhance human resources in the organization (Dean & Bowe, 1994; Hackman & Wageman, 1995; Sitkin et al., 1994). It becomes more strategic in the context of implementing new things resulting from innovation in the field of work (Hackman & Wageman, 1995; Ahire et al., 1996). This will be realized and strengthen the organizational culture towards a quality work culture. But this improvement must be based on increasing competency based on the results of the test assessment (TNA) (Suriansyah, 2017). thus the efforts to increase competence will be by the needs of the organization and individuals in the organization will improve the quality of the implementation of the main tasks and functions.

4.3. Incentives and recognition

Every human being needs recognition of his existence and what he does and requires incentives as an appreciation for what he does. Therefore it is needed a leader who can give credit to those who have fair achievements to anyone without discrimination. This recognition and appreciation can foster work motivation and increase the confidence and effort of each individual. This was stated by Ehige and Akpan (2004), Thor (1994), Awonaya (1977), Okokie (1996), Jong and Hartog (2007) and Eisenberger and Cameron (1996). Any change must be accompanied by a reward system because this will affect the achievement and implementation of changes in work.

Incentives/rewards as a reward or appreciation are not always interpreted by giving an amount of money or position, but also recognition of one's achievements and the existence of a form of appreciation will be very meaningful for an educator and educational staff and can increase work motivation. Conversely, achievements that are not recognized/valued can reduce motivation and loyalty of one's work.

4.4. Empowering and involvement educator and education

Everyone needs to be recognized what is done as a result of his thought

and work. Therefore everyone needs to be given autonomy in carrying out work without feeling tightly regulated. With autonomy can give birth to the growth and development of one's creativity. Autonomy and involving the implementers must be considered as an effort to build a sense of ownership and in the context of forming this quality culture (Aslamiah, 2019). Autonomy will increase employee involvement, communication and involvement in decision making reducing the gap between the needs of employees (educators and education personnel) and the organization (Akdon, 2006; Mosadegh, 2006).

The involvement and the empowerment of educators or teachers on making decisions, policies, guidance, SOP and some of the things that related about the matter of institution will build their responsibility feelings especially on making every decision that made. This is important and will decide the success of Total Quality Management (TQM) as an effort to build a culture of quality works (Blazey, 2002; Francois et al., 2003; Huang, 1998; Merron, 1994; Mosadegh, 2006; Lawler, Moherman, & Ledford, 1995; McAdam & Kelly, 2002;Young, Charns, & Shortell, 2001). According to Dean and Bowe (1994) and Ahire et al. (1996) this can make the organization as an organization that is always based on a quality culture and has a positive relationship with involvement in work, job satisfaction, career satisfaction and organizational commitment. The formation of a quality work culture will not succeed if empowerment and autonomy are not given.

Suriansyah (2017) and Aslamiah (2019) emphasize that there is a positive relationship between work involvement and organizational commitment in shaping individual behaviour, and work involvement is a strong predictor of organizational commitment. Someone whose work involvement is low indicates low organizational commitment.

The empowerment is indicates the process of increasing the emotional and cognitive capacity of the individuals to make some significant choices while translating them into actions. Professional empowerment is regarded under the shadow through which teachers are properly facilitated through teaching resources, time management, and various indicators of job innovation (Ddungu, 2014). Meanwhile, Suriansyah et.al (2019) recommended that university administration and other authorities should reasonably contribute to promoting the idea of teacher empowerment as it is important for the growth of the education sector. For this purpose, concern authorities should emphasize those factors which can further enhance the empowerment of teaching faculty

4.5. Autonomy in the work implementation

Everyone wants to have autonomy in carrying out work without feeling tightly because the autonomy that is given will be able to make growth and development of one's creativity. Autonomy and involving implementers must be considered as an effort to build a sense of belonging and in the context of forming this quality culture. Autonomy will increase employee involvement, communication, and involvement in decision making reducing the gap between the needs of employees (educators and education personnel) and the organization (Mosadegh, 2006). Akdon (2006) stated that autonomy will take greater responsibility for educators and education in a lower rank, which in turn gives freedom of thought and action in one group thereby increasing its commitment to an organization. While, Maassen, Gornitzka, & Fumasoli (2017) stated that institutional autonomy as the foundation of university ideology is the basis of renewal in the last decade, therefore strong leadership can be a good model for everyone and can involve everyone in making the decision (Newman et al, 2017). Involved staff will enable the development of innovative ideas because staff trust allows ideas to develop with diverse substance (Newman et al., 2017). Thus, the effectiveness and efficiency of work implementation will be higher.

4.6. Commitment & character

Multiple studies established that high commitment from the staffs for everyday works and oriented at the high quality of word based on the modal commitment indicated by the leadership to the staff. Speech, action, and performance commitments will be model for the staff (Aly & Akpoi; 2001; Cummings & Worley, 2001; Lee et al., 1999; Rivers & Bae, 1999; Powel, 1995). Therefore it needs similarity between the commitment of the leaders and the commitment of education, education staff also institutional stakeholder are one of determining elements for successful implementation of Total Quality Management (TQM) in the establishment of quality work culture (Suriansyah, 2018) because commitment is an important factor in achieving the goals that have been set (Jazzar & Algozzine, 2006).

Those are mentions above are according to Rosenholtz (1989) stated that teacher commitment has a positive relationship with organizational performance. Kushman (1992) also stated that the teacher's high commitment to the organization has a positive relationship with student academic achievement.

Many studies give the results, the teacher that has a high commitment are the important factors that influence on student learning, the academic

achievement of students Kushman (1992) and Leithwood and Jantzi (2003), and Ross and Gray (2004). Whereas students who have teachers with low attention to students and a high number of absences.

The results of the latest research have reported by Suriansyah, (2018) found that teacher commitment made a significant contribution to the creation of a conducive learning environment, and give accelerate the improvement in the quality of student learning outcomes.

The results of this research also have the similar result with the previous studies conducted by Aslamiah (2014; 2019) which states that organizational commitment influences on performance. On the other hand, internally the faculties, departments, and academics have to make necessary responses proactively and positively towards the changing trends and developments in the external environment, thereby putting new challenges to their autonomy and empowerment in terms of their knowledge expertise, research, curriculum development, instruction, management, and organizational performance (Hussin & Ismail, 2009; Ohlin, 2019; Tarman, 2016).

4.7. Participatory and collaborative leadership

Educational leadership and leader in school are believed to be the determining factors in the success of schools in achieving the desired goals. This is evident from various research results (Aslamiah, 2014; 2019; Suriansyah, 2010; 2017; Hombourg et al., 1999; Young et al., 2001) which concluded that leadership provides a major contribution not only to satisfy but also OCB and the performance (performance) of teachers in schools Previously, in Aslamiah (2019), stated that good human resource performance can be achieved through education/training, leadership and incentives available to them. of leadership is a leadership style Participatory style is an action that is needed to ensure customer satisfaction.

Wiyono (2013) states that transformational leadership tends to empower human resources effectively and efficiently, so leaders can develop strong visions, communicate goals, and create an organizational environment that encourages motivation and commitment of members to develop sustainably. This condition enables leaders to transform organizational elements through future challenges and needs. Meanwhile, Suriansyah & Aslamiah (2017) found that quality public schools were led by school principals who adopted a transformational style.

Various studies have consistently shown that leadership plays a major role in directing organizational activities to the best performance. Hesselbein and Goldsmith (2006) explain that an influential leadership profile is when a leader shows commitment to service to all people, likes people and can work with them, patience and tolerance and maturity and with them (educators and education staff) work hard. This shows that the leader has a collegial, collaborative and participative style. Successful leaders are leaders who carry out joint tasks with educators and educators as well as people they lead with together, in togetherness and for togetherness towards quality institutions. Leadership in primary and secondary schools that are successful in building quality education is the principal's leadership style that is more inclined to transformational leadership with a collectivity and collegiality approach (Aslamiah, 2019).

4.8. Periodic and continuous monitoring and evaluation

Monitoring and evaluation are one of the elements of Total Quality Management (TQM) that can formwork habits and work culture towards a better and quality work culture if done correctly and correctly target.

Monitoring and evaluation through stakeholders, educators, and education staff and even through students (students or students) to guarantee quality service (in the sense of quality work culture) is one of the important things in the TQM model. As stated by Zhao (2003) that the quality of education can be measured by student satisfaction and external customer satisfaction such as the community and parents. To ensure student satisfaction can only be done through monitoring and evaluation (monitoring and evaluation) periodically and continuously (Jong & Hartog, 2007; Hellstrom, 2006). By the opinion of Blazey et al. (2003) which states that monitoring is needed to achieve achievements because from this activity accurate, precise and objective information will be obtained. The results of monitoring and evaluation activities must be followed up with appropriate and relevant feedback for more innovative behavioural changes including quality cultural behaviour.

## V. CONCLUSION

Based on the results of the analysis and discussion as described above, it can be concluded as follows:

1. The results of quality education and accessible in the era of disruption 4.0 can only be produced through a process of quality implementation.

A quality process will produce if a quality work culture has been created in the environment.

2. A quality work culture can be developed from the belief of all people towards values, norms, vision and mission that are socialized and understood and recognized as visions, mission and values by all members of the organization. For this reason, intensive, systematic and continuous socialization is needed to build understanding and beliefs about values / norms, vision and mission as well as institutional goals.
3. To build a quality work culture, pillars are needed, namely: the foundation of the Vision, Mission and Value, the quality policy and its achievement strategies. Furthermore, the necessary character and commitment of staff, competence and professionalism, adequate autonomy for staff, empowerment and participation of all staff, appreciation and recognition of staff contributions as well as continuous and programmed development and improvement.
4. To achieve the six elements leadership is needed with a transformational, collegial and collaborative approach; transparency and accountability.
5. To ensure the process runs according to the expected quality, internal and external monitoring and quality standards from external parties are needed as a reference.

## REFERENCES


Adebanjo, D. & Kehoe, D. (1999). An investigation of quality culture development in UK industry. International Journal of Operation & Production Management, 19(7), 633- 49.

Ahire, L. S., Waller, M.A., & Golhar, D. Y. (1996). Quality management in TQM versus non-TQM Firm: an empirical investigation. International Jurnal of Quality & Reliability Management, 13(8), 8-27.

Ahmed, K.A.P., Loh, A.Y., & Zairi. (1999). Cultures for continuous improvement and Learning. Total Quality Management, 10(4/5), 426-34.

Akdon. (2006). Strategic management for educational management. Bandung, Indonesia: Alfabeta.

Alatrash, A. (2018) Impact of Using Total Quality Management on the Financial Performance of Companies Listed on the Palestine Exchange. International Journal of Business and Economic Affairs,3(6), 244-252. Doi: https://doi.org/10.24088/IJBEA- 2018-36001

Aly, N., & Akpoi, J. (2001). Total quality management in California public higher education. Quality Assurance in Education, 9(3), 127-131

Arcaro, J.S. (1995). Quality in education: an implementation handbook. Yogyakarta, Indonesia: Pustaka Pelajar

Aslamiah. (2019). Superior education in the industrial revolution Era 4.0. Banjarmasin, Indonesia: Universitas Lambung Mangkurat.

Aslamiah. (2014). Interaction between leadership and learning environment with teachers satisfaction and commitment in Banjarmasin Kalimantan (Unpublished doctoral dissertation). Universiti Utara Malaysia, Indonesia.

Awonaya, B. (1977). Expertsessing X-ray problems of education: Recommend adoption of TQM principles. Jakarta, Indonesia.

Blazey, M.L, Davison, K.S & Evans J.P. (2003). Insight to performance excellence in education. Milwoukie, Wisconsin: ASQ Quality Press.

Chen, Y.-N., Kang, J.-L., & Guo, C.-U. (2020). The construction of meta-evaluation indicators of Taiwan's university program evaluation: JCSEE program evaluation standards as a framework. International Journal of Humanities, Arts and Social Sciences, 6(2), 10-24. doi: https://doi.org/10.20469/ijhss.6.20002-1

Ciampa, D. (1991). Total quality, Reading, MA: Addison-Wesley.

Cummings, T.G., Worley, C.G. (2001), Organization development and change (7th ed.), Cincinnati, OH: Southwestern College Publishing

Cruickshank, M. (2003). TQM in the higher education sector: A literature review from an international and Australian perspective. TQM & Business Excellence, 14(10),1159- 1167.

Dean, J. & Bowe, D. (1994). Management theory and total quality improving research and practice through theory development. Academy of Management Review, 19, 392-418.

Departemen Pendidikan Nasional. (2005). Regulation of the Republic of Indonesia Number: 19 of 2005 concerning national education standards. Jakarta: Depdiknas RI.

Ddungu, L. (2014). University lecturers' professional empowerment and turnover in Uganda. Makerere Journal of Higher Education, 6(1), 35–54.

Ehige, B.O., & Akpan, R.C. (2004). Roles of perceived leadership styles and rewards in the practice of total quality management. The Leadership & Organizational Development Journal, 25(1), 24-40

Eisenberger, R., & Cameron, J. (1996). Detrimental effects of reward: Reality or myth? American Psychologist, 51, 1153-1166.

Fink, S. L. 1992. High commitment workplaces. New York, NY: Quorum Books.

Francois, P., Peyrin, J.C., Touboul, M., Labarere, J., Reverdy, T. & Vinck, D. (2003). Evaluating implementation of quality management systems in a teaching hospital's clinical department. International Journal Of Quality Health Care, 15(1), 47-55

Ghufron, G. (2018). Revolusi Industri 4.0: Tantangan, Peluang, Dan Solusi Bagi Dunia Pendidikan. Seminar Nasional Dan Diskusi Panel Multidisiplin Hasil Penelitian Dan Pengabdian Kepada Masyarakat 2018, 1(1), 1-10.

Hackman, J.R. & Wageman, R. (1995). Total quality management: empirical, conceptual, and practical issues. Administrative Science Quarterly, 309-342

Helsten, U. & Klefsjo, D. (2000). TQM as a management system consisting of values, techniques and tools. The TQM Magazine, 12(4), 238-244.

Hesselbein, F., & Goldsmith, M. (2006). The leader of the future. New York, NY: Jossey Bass Published

Hellström, A. (2006). Conceptions of process management – An anlysis of the discourse in the management literature. In The 9th International QMOD Conference. Liverpool, UK.

Homburg, C., Kohmer, D. & Workman, J.P. (1999). Strategic consensus and performance: the role of strategy type and market related dynamism. Strategy Management Journal, 20(4), 339-357.

Hoy, W. K. & Miskel, C. G. 2013. Educational administration: Theory, research and practice. New York, NY: McGraw-Hill.

Huang, Y.S., Chuan, M., & Chen, C.K. (1998), TQM implementation in Taiwan: A field study with Taiwan top 500 companies. Available at: www.sba.muohio.edu/abas/1998/titles.htm

Hussin, S., & Ismail, A. (2009). Goals, components, and factors considered in university development. Asia Pacific Education Review, 10(1), 83–91. https://doi.org/10.1007/s12564-0099001-8

Jazzar, M. & Algozzine, B. 2006. Critical issues in educational leadership. Boston: Pearson.

Jong, J.P.J., & Hartog, D.N.D. (2007). How Leaders influence employees' innovative behavior. European Journal of Innovation, 10(1), Wisconsin: Emerald Group Publishing Limited

Kanji, G.K. & Yui, H. (1997). Total quality culture, Total Quality Management, 8(6), 417- 428.

Kushman, J. W. 1992. Teacher workplace commitment. Educational Administration Quarterly, 28, 5–42.

Lawler, E. Mohrman, S.A., & Ledford, G.E. (1995). Creating high performance in fortune 1000 companies. San Fransisco, CA: Jossey-Bass Publisher.

Lee, S.F., Roberts, P., Lau, W.S., & Leung, R. (1999). Survey on Deming's TQM philosophies implementation in Hongkong, Managerial Auditing Journal, 14(3), 136- 145

Leithwood, K., Jantzi, D., & Steinbach, R. 2003. Fostering teacher leadership. In N. Bennett, M. Crawford & M. Cartwright (Eds.), Effective educational leadership, Buckingham, UK: Open University Press.

Maassen, P., Gornitzka, A., Fumasoli, T. (2017). University reform and institusional autonomy: A framework for analysing the living autonomy. Higher Education Quarterly, 7(3), 239-250. Doi: https://doi.org/71. 10.1111/hequ.12129

Manley, J.E. (1998). Symbol, ritual a dovtrine: the culture tol kit of TQM. Journal of Quality, 3(2), 175-191.

McAdam, R. & Kelly, M. (2002). A business excellent approach to generic bencmarking in SMEs, bencmarking. An International Journal, 9(1), 7-27

Memon, S. B., Soomro, S. B., and Kumar, S. (2018). Assessing the work engagement, work practices and work performance in banks. Journal of Administrative and Business Studies, 4(3), 165-184. Doi: https://doi.org/10.20474/jabs-4.3.5

Merron, K. (1994). Creating TQM organization. Quality Progress. 27, 51-54.

Mosadegh, R.A.M. (2006). The impact of organizational culture on the successful implementation of total quality management. The TQM Magazine, 18(6), 1-10.

Mukhlasin, A. (2019). Kepemimpinan Pendidikan Di Era Revolusi Industri 4.0. Jurnal Tawadhu, 3(1), 674–692

Newman, A., Scwarz, G., Cooper, B. (2017). Hor Erven Leadership Influences Organizational Citicenship Behavior: The Role of LMX, Empowerment, and Proactive Personality. Journal of Business Ethic, 145(1), 49-62. Doi: http://doi.org/10.1007/s10551-015-2827-6

Ohlin, C. (2019). Information and Communication Technology in Global Word. Research in Social Science and Technology, 4(2), 41-57.

Okokie, E.E. (1996). Total quality management implementation in Negerian companies. Management Review, 2, 39-49.

Owlia, M., & Aspinwall, E.M. (1997). TQM in higher education- a review. International Journal of Quality & Reliability Management, 14(5), 527-543.

Powel, T.C. (1995). Total quality management as competitive adventage: A review and empirical study. Strategic Management Journal, 16, 15-37

Randall, D. M., & Cote, J. A. (1991). Interrelationships of work commitment constructs, Work and Occupation, 18, 194-211.

Ristekdikti. (2018). Pengembangan Iptek dan Pendidikan Tinggi di Era Revolusi Industri 4.0. Retrieved from https://www.ristekdikti.go.id/siaran-pers/pengembangan-iptek-dan pendidikan-tinggi-di-era-revolusi-industri-4-0/

Rivers, P. A. & Bae, S. (1999). TQM implementation in health care organizations. Total Quality Management, 10(2), 281-289

Rohida, L. (2018). Pengaruh era revolusi industri 4.0 terhadap kompetensi sumber daya manusia. Jurnal Manajemen Dan Bisnis Indonesia, 6(1), 114–136.

Rosenholtz, S. J. (1989). Workplace conditions that affect teacher quality and commitment: Implications for teacher induction programs. Elementary School Journal, 89(4), 421- 439.

Rosenholtz, S. J., & Simpson, C. (1990). Workplace conditions and the rise and fall of teachers' commitment. Sociology of Education, 63, 241– 257.

Ross, J. A., & Gray, P. 2006. Transformational leadership and teacher commitment to organizational values: The mediating effect of collective teacher efficacy. School Effectiveness and School Improvement, 17(2), 179-199.

Sallis, E. (1995) Total quality management in education. London: Bidles Ltd, Guildford and Kings Lynn.

Satya, V. E. (2018). Strategi Indonesia Menghadapi Industri 4.0. Jakarta. Retrieved from https://bikinpabrik.id/wp-content/uploads/2019/01/Info-Singkat-X-9-IP3DI-Mei-2018- 249.

Schein, E.H. (1997). Organizational culture and leadership. San Farnsisco: Jossey-Bass A Wiley Company.

Sitkin, S., Sutcliffle, K. & Schroeder, R. (1994). Distinguishing control from learning in total quality management. Academy of Management Review, 19(3), 537-564

Suriansyah, A. (2010). Model of quality work culture: Case Studies in the University of Lambung Mangkurat Banjarmasin (Unpublished doctoral dissertation). University Utama Malaysia, Malaysia.

Suriansyah, A. (2017). Implementation of the total quality management model to support quality of work culture at primary school teachers education program in Lambung Mangkurat University. Australian Journal of Basic and Applied Science, 10(2), 12-20.

Suriansyah, A. (2018). Membangun Pendidikan Bermutu Berbasis Budaya Bermutu. Pidato Pengukuhan Guru Besar dalam Bidang Kepemimpinan dan Organisasi Pendidikan. Disampaikan pada acara Rapat Senat Terbuka Universitas Lambung Mangkurat, Tanggal 3 Desember 2018.

Suriansyah, A., & Aslamiah. (2018). Teacher's job satisfaction on elementary school: Relation to learning Environment. The Open Psychology Journal, 23, 1-10.

Schwab, K. (2017). The Fourth Industrial Revolution. Manhattan, NY: Crown Business Press.

Suriansyah, A., Aslamiah, N., Iwan, W., and Dalle, J. (2019). The relationship between university auotonmy, lecturer emposerment, and organizational citizenship behavior in Indonesia University. Journal of Social Studies Education Research, 10(4), 127-152.

Tarman, B. (2012). Innovation and education. research in social sciences and technology.Retreived from http://ressat.org/index.php/ressat/article/view/3

Thor, L.M. (1994). Introducing the human side of total quality management into educational institution community college. Journal of Research and Practice, 18(4), 359-368.

Vermeulen, W. (1977). Cultural change: Crucial for the implementation of TQM. Training for Quality, 5(1), 40-45.

Wilkinson, A. & Dale, B.G. (2001). Integrated management system: A model based on a total quality approach. Managing Service Quality, 11(5), 318-330.

Wiyono, B. (2013). Kepemimpinan Transformasional Kepala Sekolah (Konsep, pengukuran dan Pengembangannya). Malang: FIP UN Malang.

Young, G., Charns, M. & Shortell. (2001). Top management network effect on the adoption of innovative management practice. Strategic Management Journal, 22(10), 935-951

Zhao, F. (2003). Enhancing the quality of online higher education throught measurement. Quality Assurance in Education, 11(4), 214-221.

Zairi, M., Francis, A., Ahmad, H., Ali, N.A. & Bomtaia, K. (2007). TQM implementation- putting theory into practice example of best practices in higher education institutions. E-TQM Journals, 1(1), 1-40.

# 2. Parents' Considerations Factors in Choosing Elementary School

Muhammad Rizki, Sutarto Hadi, Sulaiman
Universitas Lambung Mangkurat, Banjarmsin 70123, Indonesia

**ABSTRACT**

Parents always want the best for their children based on their abilities, including education. For this reason, the concept of assimilation in accordance with the wishes of parents is very useful for schools in mapping prospective applicants. The purpose of this study is to identify: a) what factors that considered by students' parents in choosing schools and b) which factors are the most dominant for making decisions in determining schools. This research is a descriptive qualitative research with a multi-site design. Data in this study were collected through observation, indepth interviews, and documentation. The collected data is then analyzed with an interactive data analysis model consisting of three stages, which are: data reduction, data display, and verification or drawing conclusions. The results of this study indicate that a) the mix factors that are considered by parents in choosing a school are: product, price, location, human resources, and process; and b) the dominant factor being considered by parents in choosing schools, which are products, processes, prices, human resources and location, as well as the foundation of the school's religious philosophy and long-standing positive image. This study recommends that schools that want to increase the number of students should make an increase in the dominant factors into consideration for parents in choosing schools for their children.

Keywords: Choosing a school, marketing assimilation, students' parents

## I. INTRODUCTION

With the development of the present arrangement of life, it has an impact on various aspects of life. One of the supports of the development is

education. The demand for education is getting higher, where this is due to the increasing desire of parents also for schools as providers of educational services. Schools are continuing to grow and develop, producing a certain competition at each level. Students' parents as the community are the subject in terms of choosing a school. The school chosen by parents is a school that suits their own desires. In general, a quality school graduate as desired by the community is the result of the responsibil- ity of the school organization in accommodating human resources to be well-systemized (Aslamiah, 2015).

Based on national education rules, a good school is a school that is given autonomy and school engagement with stakeholders (Suriansyah, Aslamiah, & Sulaiman, 2014). Schools which are given autonomy will make it easier for schools to manage available resources, financial and learning support tools, prioritizing things that are deemed necessary for the needs that are indeed appropriate (Suhaimi & Efendi, 2018). A good school is a school that implements and strives to improve in a positive direction, which is strongly influenced by the quality of the principal's leadership (Suhaimi & Efendi, 2018). Performance, behavior, and culture as well as the philosoph- ical foundation of an institution greatly affect the quality of education (Suriansyah, 2018). The performance of all human resources in the school greatly affects the reputation of the school (Alamsyah, Aslamiah, & Rizalie, 2019).

The role of the leader or the school is very influential on all aspects of quality in the school. The headmaster should have a skill in managing all available resources to achieve the desired goals (Normianti, Aslamiah, & Suhaimi, 2019). Then, the party most responsible for the running of a school institution and in the context of achieving success in achieving a goal is the principal or the leader (Suhaimi & Khalik, 2018).

On the other hand, there are times when the leadership of an institution pays attention to work motivation in the workplace. According to Morgan, motivation is something that is very important in terms of achieving goals (Alamsyah, Aslamiah, & Rizalie, 2019). Motiva- tion can function to achieve the goals of an in- stitution with various approaches (Normianti, Aslamiah, & Suhaimi, 2019).

Schools that want to get optimal new students certainly have to think about aspects of the marketing assimilation. Marketing can be described as the process of defining, anticipating, creating, and meeting the needs and desires of consumers for products and services (David, 2011). Marketing ser-

vice education mix is a 7P concept consisting of: product, price, position, promotion, and people, Physical evidence, and process (Zeithaml, Bitner, & Gremler, 2013).

Initial observations were made by looking at the data on the number of New Student Admissions (PPDB) of primary schools equivalent under the auspices of the Muhammadiyah Ele- mentary and Secondary Education Board (Dik- dasmen) in the city of Banjarmasin, where there were two schools studied, MDIM 1-2 Sei. Kindaung Banjarmasin and SD Muhammadiyah 9 Banjarmasin. Preliminary observations indicate something different in terms of business related to increasing acceptance of new students. So that it has an impact on the segmentation and factors behind the parents of stu- dents in choosing a school.

A marketing concept map is needed to find out what factors are considered by parents of students in choosing a school. Improvement and ability to maintain the number of New Stu- dent Admissions is done each year at MDIM 1-2 Sei. Kindaung Banjarmasin and SD Muhammadiyah 9 Banjarmasin that were studied be- came an interesting phenomenon.

The purpose of this study is to describe the factors which are considered by students' par- ents in general in choosing a school and describe the factors which are dominant considerations of parents in choosing a school.

Information on what factors are considered by students' parents in choosing a school is needed to increase what is needed and reduce or eliminate anything that does not support school progress. In general, the mapping concept of the marketing services marketing mix is to find out and improve school curricula and programs that are in accordance with the wishes of the community. In addition, by knowing the wants and needs of parents, the school can determine the appropriate policy in winning the market, which makes the school the first choice for students' parents (Ertas, 2013).

## II. MATERIAL AND METHODS

The research approach used by researchers is a descriptive qualitative. This method is con- sidered as a relevant in the formulation of problems that require writers to conduct critical studies to explain and understand through intensive relationships with sources of data. As stated by Moleong (2007) that qualitative research intends to understand phenomena about what is experi-

enced by research subjects such as behavior, perception, motivation, ac- tion, etc. holistically, and by means of descriptions in the form of words and language in a special natural context and by utilizing various natural methods.

The design of a multicase study was carried out to hold scientific responsibility in relation to the logical relationship between the focus of research, collection, and analysis of rele- vant data. This is a multi-case study conducted at MDIM 1-2 Sei, Kindaung Banjarmasin and SD Muhammadiyah 9 Banjarmasin. Both institutions have increased and the ability to maintain the number of New Student Admissions is almost every new school year. Data sources included the principal, chairman of the foundation, chair of the Banjarmasin City Elementary and Secondary Education Assembly and students' parents.

In this study data collection was carried out observation, in-depth interviews, and documentation. The collected data is then analyzed with an interactive data analysis model consisting of three stages, namely: data reduction, data display, and verification or conclusion drawing.

## III. RESULTS AND DISCUSSION

Product Factor

In this study, researchers found various kinds of considerations of students' parents in choosing a school, of which this product factor was the most dominant factor affecting parents. If a school pays attention to this, it is possible that it will be easy to bring in registrants at each Admission of New Students per year.

Schools that are chosen by many parents regarding product factors are schools that have a strong philosophical foundation, a good school reputation and have been tested for a long time, products that can compete with superior schools, products that can be accepted in top schools and schools that have something that is compatible with what the community's demand.

Each school must have its own philosophical foundation. This is transformed into a char- acter that is seen in the attitudes and behavior of the school in each of its activities and policies. The philosophical foundation in the school studied here leads to a lot of philosophies of positive religious values, where the majority of people in Banjarmasin are very close to strong religious activities. The strength of the existing school philosophy if it produces results in the form of a number of

reputations will certainly become an added value that is owned by the school.

Schools that are targeted by parents are schools that are able to compete with other schools in terms of producing products (students) that are superior and easy to be accepted in superior destination schools. This is widely seen from the data of destination schools (Islamic Secondary School, State Secondary School, Private Secondary School and famous Islamic boarding schools) which were successfully entered by students from these two schools. The school that presents all the needs of parents of students will be easier to bring in parents who enroll their children. MDIM 1-2 Sei, Kindaung Banjarmasin is a school that tries to present a modern madrasa education, where academic and religious education is taught in the latest (the age) and the most preferred parents are students in every activity the teacher always instills positive religious values in accordance with what is desired by the students' parents. Whereas at SD Muhammadiyah 9 Banjarmasin, schools try to present academic and religious education that is no less competitive with more expensive schools around Banjarmasin at prices that are affordable by most parents of students.

From the explanation above, it can be un- derstood that the quality of the products offered by schools is an important factor for consideration by parents. The same research results were also found by Suppramaniam, Kulara- jasingam, & Sharmin (2019) who found that Parents in Bangladesh also who found that Parents in Bangladesh also took into account the quality of the school as the basis for select- ing schools for their children. The quality of the school in question is whether the school can produce students who excel and whether after graduating they can easily proceed to a superior school.

Price Factor

Based on the data found, related to the price of the opinions of parents in the two schools studied became a dominant factor in influencing parents in choosing a school. MDIM 1-2 Sei. Kindaung Banjarmasin and SD Muhammadiyah 9 Banjarmasin in terms of payment almost have in common, which is suitable for the lower mid- dle class. Many parents think that schools are very accommodating in terms of prices so they can be cheaper with quality that is not inferior to schools that charge higher prices. And there are some parents of students who think that the quality of education of the two schools ex- ceeds other superior schools. As a result there are many students' parents who feel that they made a right choice.

The price factor is undeniably very im- portant to attract the attention of people to choose a school. Not only for elementary education level, even for secondary and higher education level. As happened in Sub-Saharan Africa, free school fees can attract parents and students to enroll to higher education (Koski, et al., 2018). Conversely an increase in tuition fees could have an impact on decreasing the number of students who continue their studies (Hemelt & Marcotte, 2011). The cost of education proves to be very important for students and parents in determining the school, as happened in Qatar where prospective students make education costs a crucial consideration (Mustafa et al., 2018). Even something similar happened in the UK, an increase in the cost of education also resulted in a decrease in the number of students who continued their stud- ies to University (Wilkins, Shams, & Huisman, 2013).

Location Factor

For location factors, the two schools have many similarities, such as 1) located in the middle of the city, 2) located in a narrow alley and 3) near a densely populated settlement. Even so the existence of parents is not too concerned about these things, because the most important is the location of the school is still easy to access for transportation between two-wheeled vehicles and environmental conditions that are safe and conducive. For parents at MDIM 1-2 Sei, Kindaung Banjarmasin, location factor is not dominant, but for parents at SD Muhammadiyah 9 Banjarmasin location is the dominant factor in choosing schools.

At SD Muhammadiyah 9 Banjarmasin, the location of the school is in a narrow alley and in the middle of a densely populated settlement. But the added value of this school is that the school is located in the middle of the city of Banjarmasin (the main street of the city), so it is very strategic to become a school that wants to position itself as a superior school and can have an impact on bringing the number of par- ticipants New Student Admissions to increase dynamically every year.

The location that facilitates access to transportation is one of the considerations which are taken into account by parents in choosing a school for their children (Sharma & Tripathi, 2016). The easier access is, the easier students will go to school either transfer by their parents or departing using public transportation. However, if viewed from the side whether the loca- tion of the school affects learning achievement, the results of research conducted by Ntibi & Edoho (2017) found that there was no difference in learning achievement caused by differences in school locations. Therefore, it can be said that the

location of the school is only a con- sideration in terms of accessibility.

Promotion Factor

Among all the factors that exist, the promo- tion factor carried out directly is a factor that is not dominant for parents in choosing a school. Among the many interview data findings and documentation of the New Student Admission registration form, many parents who choose schools are influenced by indirect promotion. The indirect promotion means the parents of students who directly look directly into the products of a school (the results of the students 'and academics' formation). This is the main thing parents want.

MDIM 1-2 Sei, Kindaung Banjarmasin and SD Muhammadiyah 9 Banjarmasin in the past few years have done many direct promotions, for example 1) coming directly to the targeted Kindergartens 2) installing banners at various strategic points 3) distributing brochures in strategic places etc., but has little impact on in- creasing the number of registrants.

The product of a service company may be wrong consumers in choosing one time, but parents of students in choosing a school do not want to wrong in choosing a school. Moreover, those parents who enroll their children in private schools for more than public primary schools are parents who really want something that is better for their children.

The purpose of the promotion is to make the school known. By being known by the com- munity, it will be able to build public confidence that the school is categorized as a good school, because one indicator that the school is good is well known in the community (Rico-Briones & Bueno, 2019). Famous which is referred here is having a good academic reputation, because a school that has a good reputation will be able to attract the attention of parents (Bosetti, 2004).

Human Resource Factors (HR)

Human resource factor (HR), for parents at MDIM 1-2 Sei, Kindaung Banjarmasin is indeed very dominant in influence, whereas for parents in SD Muhammadiyah 9 Banjarmasin is not dominant in influencing when choosing a school.

There are a number of findings related to HR in MDIM 1-2 Sei, Kindaung Banjarmasin, which made many parents choose this school, such as 1) the school has role models who have close and wide family and community rela- tions, 2) leaders who are also active in socio-religious organizations and 3)

teachers and education personnel who are indeed famous for educating a strong philosophical foundation by the school. These 3 (three) things very much influence the parents' interest in choosing this school for their children.

The quality of teaching staff will affect stu- dent achievement. As found by Darling-Ham- mond (2000) that improving teacher quality has implications for increasing student achievement. Even the quality of teachers does not only affect the ability of students in academic matters, but also is proven able to shape the attitudes and behavior of students (Blazar & Kraft, 2017). Positive things from a teacher will have a positive effect on students. Like for example, the enthusiasm of teachers in teaching will affect student activity in the learning process (Mahler, Großschedl, & Harms, 2018). Likewise with teacher communication, good communication between teacher and students both verbal and non-verbal will affect the mood of students while learning and subsequently will have implications for their learning outcomes (Bambaeeroo & Shokrpour, 2017).

Neither on the contrary, if the teacher is not motivated to teach it will negatively affects stu- dent motivation and learning outcomes (Shen, et al., 2015). In addition, the way teachers' pay attention to students in class is also proven to affect student learning achievement, teachers who are able to give proportional attention to students will help students in improving their learning achievement (Kiany & Shayestefar, 2011). Thus, training to improve teacher quality is very necessary, because through appro- priate training the teacher can improve the quality of the learning process which at the same time can improve student achievement (Webster-Stratton, Jamila Reid, & Stoolmiller, 2008).

Seeing the effect of teacher quality on student achievement and attitudes it is very natural that parents make the quality of teachers one of the considerations in choosing a school for their children. Similar research results were found by Yaacob, Osman, & Bachok (2015) who found that teacher quality was an important factor for parents in choosing schools for their children. Unlike the MDIM 1-2 Sei, Kindaung Banjarmasin, SD Muhammadiyah 9 Banjarmasin, does not emphasize the central figure but on the strength of the attractiveness of human resources in the school as a whole with everything in the school, where parents look at the school not only the attractiveness of the teacher but also all in school. Similar research results were also found by Bosetti (2004) which found that parents chose schools for their children based on the academic reputation of the school which included the reputation of the principal, teachers, staff, and student achievements.

Facilities and Infrastructure Factors

Similar to the promotion factor, for facilities and infrastructure factors or facilities are not dominant in influencing parents of students in choosing a school. Both schools are indeed schools that are still incomplete in terms of facilities and infrastructure, both for academic activities and other supporting activities. The parents who were met for the two research schools were not concerned with the completeness of the facilities and infrastructure of a school, what they prioritized was the quality of the products and processes in the school. The school always tries to always complement what is still lacking and is indeed needed. Related to this, the school has already established several collaborations with third parties in terms of fulfilling facilities and human resources, for exam- ple renting a sports hall, bringing in a drum band trainer, etc. And all of this in the eyes of the parents of students, the school has tried to always try to meet the completeness of facilities and infrastructure.

However, that does not mean that schools can ignore the supporting facilities for the im- plementation of learning. Research conducted by Adebayo (2009) found that, for the case in Nigeria, parents made the availability and qual- ity of learning facilities one of the reasons for choosing a school for their son or daughter. The results of the study were also supported by Akhter (2017) which also found that parents in Pakistan made facilities, primarily the use of the latest technology by schools, a consideration in choosing schools.

Facilities as consideration are reasonable; given the existence of learning support facili- ties will be able to improve student learning achievement (Ramli & Zain, 2018). This is sup- ported by the results of research conducted by Ibe and Abamuche (2019) who found that the use of audiovisual-based learning media was able to increase students' interest in learning and presenting. Moreover for children of age, the use of technology will make learning more interesting (Baharuddin & Dalle, 2019). Furthermore, the use of technology also makes learning more effective and flexible because the learning process makes it possible to be done anytime and anywhere (Dalle, Hadi, Baharuddin, & Hayati, 2017). Likewise with re- search conducted by Lumpkin, J., Hope, & Lutfi (2014), who found that the quality of school buildings and their supporting facilities affected student learning achievement. That is because students who feel happy with the look of the school will be proud of the school and have a sense of ownership of the school so they will be happy to go to school (Williams et al., 2018).

Furthermore, the quality of buildings and supporting facilities will affect the comfort; en- thusiasm and safety of students in learning so that they can learn well and achieve optimal performance (Cheryan, Ziegler, Plaut, & Meltzoff, 2014). School safety will be very im- portant in the learning process, with the avail- ability of supporting facilities such as CCTV that can prevent accidents or other safety problems such as fights between students will make the school atmosphere more conducive. Bearing in mind the increasingly widespread cases of violence in schools, the security and order of schools is very much needed to be improved to make the learning process more optimal (Cornell & Mayer, 2010).

Process Factor

The process factor is one of the mixed concepts which is one of the dominant factors affecting parents in choosing a school. The process at school becomes the focus of attention that is most prioritized by parents of students, ranging from matters directly related to students or those that are not directly. Here the parents choose the school by paying attention 1) relating to Teaching and Extracurricular Learning Activities and 2) relating to the inculcation of positive values in every process in the school. Positive values here are religious moral values which parents cannot teach at home.

Teaching and extracurricular activities or other activities at school at MDIM 1-2 Sei, Kindaung for parents is very much in accordance with what they want, which is to inculcate religious moral values in accordance with religious teachings and understandings adopted by the majority of parents of students in school. These values are already known by parents of various kinds of information; alumni, family, neighbors and relatives, and is reflected in the daily lives of students who are and or are already attending MDIM 1-2 Sei. Kindaung Ban- jarmasin. So that most parents want their chil- dren to also get teaching and education related to the inculcation of values.

Almost the same as MDIM 1-2 Sei, Kindaung Banjarmasin, SD Muhammadiyah 9 Banjarmasin was chosen by parents because of the process factors in this school. Many parents con- sider this school capable of educating their children, which is no less competitive with other superior schools around East Banjarmasin, of course at a more affordable price. So that parents consider this school to be very accommodating to

the needs of students and parents in terms of religious basic education.

A good learning process will have a positive effect on student achievement. The interaction between teacher and student is one indicator in a good learning process. If the interaction between students and teachers is carried out well there will be a good emotional bond between the teacher and students that makes students feel comfortable when the learning process takes place which will then form a conductive learning climate so that it will have an impact on improving learning achievement (Allen, et al., 2013). With the creation of emotional close- ness, it will create an active learning atmos- phere, because students will feel comfortable in asking questions and delivering the problems they face during the learning process to the teacher (Pöysä, et al., 2019). These results are also supported by research findings Martin and Rimm-Kaufman (2015), that is, a strong emotional connection between teacher and student is able to make students interact more actively in the class, even though they are students with less confidence. In addition to strengthening emotional relationships, teacher and student interactions will form organizational relation- ships, and a learning culture that is very important in teaching and learning (Hafen, et al., 2015). The culture will further shape the classroom and school climate, which will play an im- portant role in shaping the harmony of the school community, if all school members have close social relations then if there are problems, especially for students, they will soon be able to know and find solutions. (O'Brennana, Bradshawa, & Furlong, 2014).

The student-centered learning process can also be an indicator that the learning process is well implemented. One example of student-centered learning is collaborative learning. Collaborative learning is very important to be car- ried out considering the ability to work together is very necessary in the world of work which is the future of children (Premo, Cavagnetto, Davis, & Brickman, 2018).

Dominant Factors that Students' Parents *Consider in Choosing Schools*

Factors that dominate students' parents' considerations in choosing a school are product, process, price, location and HR. In addition, there were also other factors which became a consideration for parents of students in choosing a school. Among the various findings, at least in general

these other factors such as philosophical foundations in religious-based schools where parents consider the school can provide good religious education by also providing general education that can compete with other superior schools (not old-fashioned).

The philosophical foundation of the two schools is considered by parents to have a large spirit and is well defended. Then, it becomes a positive image that can be maintained from generation to generation which makes many parents who know and ultimately choose the school from the recommendations of their extended family who have long been alumni of the two schools. As a result, the philosophical foundation factor and the ability to maintain the school's morale became a supporting factor to the concept of mix that made the two schools eligible to be selected.

The process collectivity will produce school products. MDIM 1-2 Sei. Kindaung Banjarmasin is a school that has been established for a long time since 1921, many achievements have been made by this school both in the academic and religious fields. It is not easy for this school to maintain that reputation. With this reputation, many alumni have sent their children back to school in this school. They alumni want their descendants to get the same education (process). Whereas at SD Muhammadiyah 9 Banjarmasin, parents chose this school because they thought the processes and products produced could compete with superior schools and schools that were more in terms of price. So that schools are considered to be very accommodating for parents who want affordable prices but get good and optimal education for religious and general education. In which that has succeeded in building a positive image in society for a long time.

If simplified, the deciding factor for parents to choose a school for their children is the quality of the school (Maangi, 2014). Parents want to choose the best school for their children, even though the best definition from each parent's side may be different so it cannot be explained in a simple description (Thanerajah & Razilan, 2017). The definition of quality by parents is usually influenced by their socioeco- nomic background, i.e. there is a tendency that parents with higher incomes will prioritize schools with high academic reputations as their priorities (Burgess, Greaves, Vignoles, & Wilson, 2014).

Table 1. Cross Site Data Analysis

| Variable | Site 1<br>MDIM 1-2 Sei. Kindaung Banjarmasin | Site 2<br>SD Muhammadiyah 9 Banjarmasin |
|---|---|---|
| **Product Factor** | • The school has a strong philosophical foundation<br>• Good school reputation (academic and religious), and many achievements in various championship events.<br>• Products that can compete with other school graduates<br>• Can be accepted by schools<br>• Provision of religious knowledge that is widely accepted by students | • Good school reputation (academic and religious)<br>• Products that can compete with other school graduates<br>• Can be accepted by favorite schools |
| **Price Factor** | Schools are considered by parents to be quality schools but with affordable fees, so many are chosen by them | With a more reasonable price than a more expensive school, you can get the same results and even more. |
| **Location Factor** | Parents choose schools because of the quality of products and processes that are difficult to obtain elsewhere, so even though parents are far away, they still want to send their children to school at this school | The school is in the middle of the city, which makes it easy for parents to pick up their children. |
| **Promotion Factor** | Only a few parents know about acceptance through promotions. | For parents who really want to send their children to school in this school are actively looking for themselves into schools to find out how the process in a school and see firsthand from their closest relatives. |
| **HR Factor** | • There is a populist leadership figure in which he has many and extensive kinship, and he is active in various social and religious organizations.<br>• Teachers who are widely known by parents and have kinship in kindergartens and day care centers around this school. | Many parents of students who see from the products and processes in this school collectively from all aspects of support in the school |
| **Facility Factor** | Parents are more concerned with the quality of products and processes. | Parents are more concerned with the quality of products and processes. |
| **Process Factor** | Parents are very concerned about all activities in the school such as; Teaching and learning activities, extracurriculars, and what parents want most is the process of inculcating positive values in all existing activities and that is found by parents in this school. | Parents are very concerned about all activities in the school such as; Teaching and learning activities, extracurriculars, and what parents want most is the process of inculcating positive values in all existing activities and that is found by parents in this school. |
| **Other Consideration Factors** | The philosophy and school spirit that can be maintained from generation to generation | The positive image of the school is generated from the reputation and products of the school |

| Variable | Cross-Site Research Findings Factors of Students' Parents' Considerations in Choosing Schools |
|---|---|
| **Product Factor** | Students' parents in choosing schools with consideration:<br>• School reputation<br>• School students and alumni can compete with other schools<br>• Can be accepted in top schools |
| **Price Factor** | Parents of students choose schools with consideration that if there are schools with more affordable prices and the same quality as more expensive schools, then cheaper schools are preferred |
| **Location Factor** | Students' parents choose location-related schools with consideration:<br>• Make it easier for parents to pick up and drop<br>• safe and conducive environment |
| **Promotion Factor** | Students' parents choose schools through indirect promotion, which is through the processes and products of the school that are seen directly by the community. |
| **HR Factor** | Regarding HR, parents chose the school with consideration:<br>• There is a figure (teacher) in the school who has the ability to establish close and wide relationships in the community<br>• Teachers who truly protect students sincerely in delivering positive values |
| **Facility Factor** | Students' parents choosing schools do not pay much attention to the facilities provided by the school |
| **Process Factor** | Students' parents choose schools with consideration of teaching and learning activities, extracurricular activities and activities to instill positive values in every activity in the school |
| **Other Consideration Factors** | Students' parents in choosing schools with consideration:<br>• Philosophical foundation in the school in accordance with the community's demand<br>• A positive image of a school that has been built for a long time |

## IV. CONCLUSION AND RECOMENDATION

The strain S. prasinopilosus Pn-TN2 which isolated from termite nest sample, showed a broad range of antimicrobial activity against bacterial and fungal test. Result showed that this isolate possessed inhibition rate antifungal activity by 80% against F. oxysporum, 61% against F. palustris, and 62% against T. viridae. Advised, this isolate also possessed high antibacterial activity against B. subtilis, P. aeoginosa, and E. coli. Sequence analysis of 16S rRNA gene indicated that isolate Pn-TN2 be-longs to genus Streptomyces. It shares 99% similarity with S. prasinopilosus. We conclude that termite nest represent source of cultivable Actinomycetes that contribute diverse bioactivecompounds for further biotechnology application in the medical, pharmaceutical, and agricultural fields.

## V. ACKNOWLEDGMENT

We express our gratitude to all our colleagues from the Educational Management Postgraduate Program atUniversitasLambung Mangkurat. In addition to our colleagues, we also sincerely thank our best instructor Dr. Dalle Juhriyansyah. His guidance really helped us while writing the article. We are very grate-ful having an instructor and mentorwho ispa-tient in giving direction to our writing.

## REFERENCES


Adebayo, F. A. (2009). Parents' Preference for Private Secondary Schools in Nigeria. International Journal of Education Science, 1(1), 1-6.Akhter, N. (2017). Factors Affecting Parents' Inclination towards Private School System in Pakistan. *Journal of Elementary Education*, 27(2), 49-69.

Alamsyah, Aslamiah, & Rizalie, M. (2019). School based management implementation to improve school quality of multi sites study in SDN alalak selatan 2 dan SDN alalak selatan 4 Banjarmasin city. *International Journal of Scientific Development and Research*, 4(1), 2455-2631.

Allen, J., Gregory, A., Mikami, A., Lun, J., Hamre, B., & Pianta, R. (2013). Observations of effective teacher–student interactions in secondary school classrooms: Predicting student achievement with the classroom assessment scoring system-secondary. *School Psychology Review*, 42(1), 76-98.

Aslamiah. (2015). *Hubungan kepemimpinan transformasional kepala sekolah, kepuasan kerja, komitmen organisai, dan organizational citizenship behavior (OCB) dengan kinerja guru sekolah dasar negeri di kota banjarmasin*. Malang: Program Studi Manajemen Pendidikan Pascasarjana Universitas Negeri Malang.

Baharuddin, & Dalle, J. (2019). Transforming Learning Spaces for Elementary School Children with Special Needs. *Journal of Social Studies Education Research*, 10(2), 44-365.

Bambaeeroo, F., & Shokrpour, N. (2017). The impact of the teachers' non-verbal communication on success in teaching. *Journal of Advances in Medical Education & Professionalism*, 5(2), 51-59.

Blazar, D., & Kraft, M. A. (2017). Teacher and teaching effects on students' attitudes and behaviors. Educational Evaluation and Policy Analysis,146-170.Bosetti, L. (2004). Determinants of school choice: Understanding how parents choose. *Journal of Education Policy*, 19(4), 387-405. doi:10.1080/0268093042000227465

Burgess, S., Greaves, E., Vignoles, A., & Wilson, D. (2014). What parents want: School preferences and school choice. *The Economic Journal*, 125, 1262–1289. doi:10.1111/ecoj.12153

Cheryan, S., Ziegler, S. A., Plaut, V. C., & Meltzoff, A. N. (2014). Designing classrooms to maximize student achievement. *Policy Insights from the Behavioral and Brain Sciences*, 1(1), 4–12. doi:https://doi.org/10.1177/2372732214548677

Cornell, D. G., & Mayer, M. J. (2010). *Why do school order and safety matter? Educational Researcher*, 39(1), 7–15. doi:10.3102/0013189X09357616

Dalle, J., Hadi, S., Baharuddin, & Hayati, N. (2017). The Development of Interactive Multimedia Learning Pyramid and Prism for Junior High School Using Macromedia Authorware. *TOJET: The Turkish Online Journal of Educational Technology*, 2017(Special Issue), 714-722.

Darling-Hammond, L. (2000).Teacher quality and student achievement: A review of state policy evidence. *Education Policy Analysis Archives*, 8(1), 1-44.

David, F. R. (2011). *Strategic Management Manajemen Strategi Konsep* (12th ed.). Jakarta: Salemba Empat.

Ertas, N. (2013). *Charter Schools and Student Compositions of Traditional Public Schools*. SAGE Open, 2013, 1–13. doi:https://doi.org/10.1177/2158244013494207

Hafen, C. A., Hamre, B. K., Allen, J. P., Bell, C. A., Gitomer, D. H., & Pianta, R. C. (2015). Teaching through interactions in secondary school classrooms: Revisiting the factor structure and practical application of the classroom assessment scoring system-secondary. *The Journal of Early Adolescence*, 35(5-6), 651–680. doi:10.1177/0272431614537117.

Hemelt, S. W., & Marcotte, D. E. (2011). The Impact of Tuition Increases on Enrollment at Public Colleges and Universities. *Educational Evaluation and Policy Analysis*, 33(4), 215–229. doi:10.3102/0162373711415261

Ibe, E., & Abamuche, J. (2019). Effects of audiovisual technological aidson students' achievement and interest in secondary school biology in Nigeria. *Heliyon*, 5(2019), e01812. doi:https://doi.org/10.1016/j.heliyon.2019.e01812

Kiany, G. R., & Shayestefar, P. (2011). High school students' perceptions of EFL teacher control orientations and their English academic achievement. *British Journal of Educational Psychology*, 81(3), 491-508. doi:https://doi.org/10.1348/000709910X522177

Koski, A., Strumpf, E. C., Kaufman, J. S., Frank, J., Heymann, J., & Nandi, A. (2018). he impact of eliminating primary school tuition fees on child marriage in sub-Saharan Africa: A quasi-experimental evaluation of policy changes in 8 countries. *Plos One*,13(5), e0197928. doi:https://doi.org/10.1371/journal.pone.0197928

Kotler, P., & Amstrong, G. (2018). Principles of Marketing. London: Pearson Education Limited.Lumpkin, R. B., Jr., R. T., Hope, W. C., & Lutfi, a. G. (2014). *Code Compliant School Buildings Boost Student Achievement*. SAGE Open, 2014, 1-8. doi:https://doi.org/ 10.1177/2158244014556993

Maangi, E. N. (2014). Factors Influencing Parental Patronage of Private Primary Schools in Kenya Despite Free Primary Education (FPE) in Public Schools. *Journalof Education and Practice*, 5(26), 119-128.

Mahler, D., Großschedl, J., & Harms, U. (2018). Does motivation matter? -The relationship between teachers' self-efficacy and enthusiasm and students' performance. *Plos One*, 13(11), e0207252. doi:https://doi.org/10.1371/journal.pone.0207252

Martin, D. P., & Rimm-Kaufman, S. E. (2015). Do student self-efficacy and teacher-student interaction quality contribute to emotional and social engagement in fifth grade math? *Journal of School Psychology*, 53(5), 359-373. doi:https://doi.org/10.1016/j.jsp.2015.07.001

Moleong, L. J. (2007). *Metodologi Penelitian Kualitatif (Qualitative Research Method)*. Bandung: PT. Remaja Rosdakarya Offset.

Mustafa, S. A.-A., Sellami, A. L., Elmaghraby, E. A., & Al-Qassass, H. B. (2018). Determinants of college and university choice for high-school students In Qatar. *International Journal of Higher Education*, 7(3), 1-16. doi:10.5430/ijhe.v7n3p1

Normianti, H., Aslamiah, & Suhaimi. (2019). Relationship of transformational leaders of principal, teacher motivation, teacher organization commitments with performance of primary school teachers in labuan amas selatan, Indonesia. *European Journal of Education Studies*, 5(11), 2501-1111.

Otibi, J. E.-E., & Edoho, E. A. (2017). Influence of school location on students attitude towards mathematics and basic science. *British Journal of Education*, 5(10), 76-85.

O'Brennana, L. M., Bradshawa, C. P., & Furlong, M. J. (2014). Influence of classroom and school climate on teacher perceptions of student problem behavior. *School Mental Healt*h, 6(2), 125–136. doi:10.1007/s12310-014-9118-8

Poernamawijaya, L. W., Sulaiman, S., Suriansyah, A., & Dalle, J. (2018). Contribution on supervision of supervisor, principals motivation, kindergarten teacher performance to improving the kindergarten quality in west Banjarmasin, Indonesia. *European Journal of Alternative Education Studies*, 3(2), 129-146. doi:doi: 10.5281/zenodo.2261031

Pöysä, S., Vasalampi, K., Muotka, J., Lerkkanen, M.-K., Poikkeus, A.-M., & Nurmi, J.-E. (2019). Teacher–student interaction and lower secondary school students' situationalengagement. *British Journal of Educational Psychology*, 89(2), 374-392. doi: https://doi.org/10.1111/bjep.12244

Premo, J., Cavagnetto, A., Davis, W. B., & Brickman, P. (2018). Promoting Collaborative Classrooms: The Impacts of Interdependent Cooperative Learning on Undergraduate Interactions and Achievement. *CBE Life Sciences Education*, 17(2), ar32. doi:https://doi.org/10.1187/cbe.17-08-0176

Ramli, A., & Zain, R. M. (2018). The impact of facilities on student's academic achievement. Science International, 30(2), 299-311.Rico-Briones, E., & Bueno, D. C. (2019). Factors affecting the decision of first year students in choosing their degree program and school. Institutional *Multidisciplinary Research and Development Journal*, 2, 130-135. doi:10.13140/RG.2.2.25060.01921

Sharma, A., & Tripathi, V. N. (2016). Factors affecting enrolment trends in government and private schools at elementary level as perceived by teachers and parents. *Scholarly Research Journal for Interdiciplinary Studies*, 4(27), 3189-3198.

Shen, B., McCaughtry, N., Martin, J., Garn, A., Kulik, N., & Fahlman, M. (2015). The relationship between teacher burnout and student motivation. *British Journal of Educational Psychology*, 85(4), 519-532. doi: https://doi.org/10.1111/bjep.12089

Suhaimi, & Khalik, A. (2018). Kepemimpinan transformasional kepala sekolah pada SMP 4 muhammadiyah. *Jurnal Penelitian Tindakan dan Pendidikan*, 4(1), 37-46.

Suhaimi, & Nuryadin, E. (2018). Hubungan peran kepala sekolah dan sikap terhadap profisi guru dengan prestasi kerja guru SMA negeri di kabupaten hulu sungai selatan. *LENTERA Jurnal Ilmiah Kependidikan*, 13(1), 73 –83.

Suppramaniam, S., Kularajasingam, J., & Sharmin, N. (2019). Factors Influencing Parents Decision in Selecting Private Schools in Chittagong City, Bangladesh. *International Journal of Recent Technology and Engineering*, 7(5S), 318-330.

Suriansyah, A., & Aslamiah. (2018). *Strategi kepemimpinan kepala sekolah, guru, orang tua, dan masyarakat dalam membentuk karakter siswa*. Banjarmasin: Universitas Lambung Mangkurat.

Suriansyah, A., Aslamiah, & Sulaiman. (2014). *Strategi pembelajaran (Teaching strategy)*. Jakarta: Raja Grafindo Persada.

Thanerajah, V. R., & Razilan, R. B. (2017). Factors That Influence Parents on Choosing Choosing international private schools ahead of government schools in Malaysia. *International Journal of Accounting & Business Management*, 5(1), 111-128. doi:24924/ijabm/2017.04/v5.iss1/111.128

Wasito, H. (1992). *Pengantar Metodologi Penelitian: Buku Panduan Mahasiswa (Introduction to Research Methodology: Student Handbook)*. Jakarta: PT. Gramedia Pusaka Utama.

Webster-Stratton, C., Jamila Reid, M., & Stoolmiller, M. (2008). Preventing conduct problems and improving school readiness: evaluation of the Incredible Years Teacher and Child Training Programs in high-risk schools. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 49(5), 471–488. doi:https://doi.org/10.1111/j.1469-7610.2007.01861.x

Wilkins, S., Shams, F., & Huisman, J. (2013). The decision-making and changing behavioural dynamics of potential higher education students: the impacts of increasing tuition fees in England. *Educational Studies*, 39(2), 125-141. doi:https://doi.org/10.1080/03055698.2012.681360

Williams, S., Schneider, M., Wornell, C., & Langhinrichsen-Rohling, J. (2018). Student's perceptions of school safety: It is not just about being bullied. *The Journal of School Nursing*, 20(10), 1-12. doi:10.1177/1059840518761792

Yaacob, N. A., Osman, M. M., & Bachok, S. (2015). An assessment of factors influencing parents' decision making when choosing a private school for their children: a case study of Selangor, Malaysia: for sustainable human capital. *Procedia Environmental Sciences*, 28(1), 406-417. doi:10.1016/j.proenv.2015.07.050

Zeithaml, V., Bitner, & Gremler. (2013). *Service Marketing-Integrating Customer Focus Across The Firm*. New York: McGrawHill.

# 3. Role of School Heads in Improving Quality of Education (Studi of Multi Side SDN SN Pasar Lima 1 and SDN Sungai Miai 10 Banjarmasin)

Rachmadinoor, Sutarto Hadi, Suhaimi
Lambung Mangkurat University, Banjarmasin, Indonesia

**ABSTRACT**

This research is based on researcher curiosity about how two different schools improved their quality of education through the role of the principal. One of school is a large school with a "National Standard", and the other is an ordinary core school, but both of them have the same capability in improvement good education quality in their schools. This research was purposed to determine (1) the role of principal in improving the quality of education in scholls (2) supporting and inhibiting factors in improving the quality of education in schools. This research was carried out at SDN SN Pasar Lama 1 and SDN Sungai Miai 10 Banjarmasin. This research uses descriptive qualitative research. Using the method used in this study to study definitions and meanings that are more specific to environmental conditions. For those of these are (1) principals (2) teachers and staff (3) school committees (3) parents of students. The results of this research are as follows: (1) the role of the principal as an educator, manager, administrator, supervisor, leader, innovator, motivator, each has its own functions and purposeful and has much impact on improving the quality of education in schools, profesional principals are principals who are able to carry out all of these roles well and with high dedication so that improving the quality of education in schools can be achieved optimally. (2) supporting factors for improving the quality of education in schools are teachers who have the competence of professionalism in carrying out their duties, and the inhibiting factors in improving the quality of education is the lack discipline teachers in

providing lessons to students so that the purposes of improving the quality of education cannot be carried out properly.

Index Terms: Principal Role, Quality of Education.

## I. INTRUDUCTION

Education is the basis of the development of a country, therefore education is the foundation for progress in all aspects of life in society and state. Education is seen from the point of view of statesmen as an "instrument" that is very important for every country to increase its competitiveness in the world of law, economics, politics, culture, and also the defense of a whole world society. At this time it can be said that developed countries are countries that always improve their quality in the field of education, so it will also have an impact on their competitiveness.

Syafaruddin in his book (2002: 87) argues that in the national education system in Indonesia, schools have a very strategic role as an institution that organizes educational activities. Therefore, it can be said that the school carries a very heavy mandate in the progress and improvement of the quality of education, this is because the school will face various challenges and obstacles regarding the development of the times that will continue to grow rapidly along with the development of the world of Science and Technology (Science and Technology) Education is currently faced with a variety of problems, as a result of people's expectations for quality education and produce their intelligent and character-bearing sons and daughters who have yet to be fulfilled by education providers Suriansyah et al (2015).

A problem that is experienced today in the world of education, especially in the country of Indonesia is the quality of education quality. The quality of education quality is related to every level of education in schools, especially at the level of primary education and secondary education. In the world of education, schools have a very important role as a place to provide educational services, so it can be concluded that schools are the most responsible and influential institution or place in the quality of education in a country.

The most important and main person and at the front line at the operational level of education in school is a school principal. the principal's figure has a very strategic role in advancing the quality of education of a school. As a figure who is at the forefront of school, of course the role of the principal is

very important for the advancement of the quality of education in the school in his school.

The principal has an important role in determining and achieving success in a school, if the principal is able to manage all the resources in the school, the high quality of education can be achieved according to wishes and expectations, and vice versa if the principal does not have the ability to manage all the resources in the school, it is very likely that the school will be underdeveloped. Thus it can be concluded that the role of the principal is very important and has a big influence on the progress of the quality of education in his school, so it is very reasonable if the low quality of education in schools, one of the factors is the role of principals who do not meet the criteria of good and ideal.

In this study, researchers took the subject of research on the role of the principal in improving the quality of education in his school. Researchers conducted research in two schools, namely SDN SN Pasar lama 1 and SDN Sungai Miai 10 Banjarmasin, the difference in this school was; on the one hand, SN Pasar Lama 1 SDN is a large, advanced and high-achieving school that has become the "reference school" of education quality at the city level of Banjarmasin. On the other hand Sungai Miai 10 Elementary School is a small school, but this school is also able to provide good service in providing quality education in schools. This is where researchers want to explore more about the role of the principal in improving the quality of education in the school he leads.

The right relationship between the title of the thesis that the researcher raised about the role of the school principal with the selection of this school is that the school is entrusted by the City Education Office to become a school as a place of practic /learning "on" the prospective principals throughout Banjarmasin, who have finished implementing "in" "From the stages of the procedure to being the principal. Another factor of excellence from this school is; SDN SN Pasar Lama 1 became the representative of South Kalimantan in the "Quality Culture" competition and successfully entered the national level in November 2017, aspects of the quality culture here are (1) School Based Management (SBM). (2) Learning. (3) Library (4) UKS (5) Extracurricular. Even though at the national level it does not win, (in the top 10 in Indonesia) but it is still a remarkable achievement and success because it can reach the national level.

In other objects in Sungai Miai 10 Elementary School, it is very interesting to study, considering that this school is not a Pilot School, National Standards especially International Schools but is able to obtain a very proud value

of National Examination from previous years up to now, proven in April 2017 earlier: the 6th grade students of Sungai Miai 10 Elementary School were ranked 1st in the highest Mathematics score in Banjarmasin City 2016/2017 academic year. The other academic achievements of this school are city, provincial and national, namely; won Second Place in Banjarmasin City Level Mathematics National Science Olympiad Competition, Second Runner Up in South Kalimantan Province and National Top 10 Rankings in Jakarta 2015/2016 academic year. This achievement is all, of course, can not be separated from the role of a school principal who has led and improved the quality of education in the school he has built. Mulyasa (2007) explained that principals must at least have a role and function in carrying out their duties, namely as "Educators, Managers, Administrators, Supervisors, Leaders, Innovators and Motivators (EMASLIM)".

Of the two schools described above, of course this is a very interesting thing to study, on the one hand SDN SN Pasar Lama 1 is a large and advanced referral school, and SD Miai 10 Elementary School which is able to become a school that has high learning achievement even outperformed other schools, therefore the author will conduct a study of the two schools entitled "The Role of School Principals in Improving the Quality of Education (Multi-Site Study of SDN SN Pasar Lama 1 and SD Miai 10 Banjarmasin)"

## II. RESEARCH PURPOSES

What is the role of the principal as an educator, manager, administrator, supervisor, leader, innovator and motivator in improving the quality of education in schools

## III. RESEARCH METHODOLOGY

Based on the above problems, the qualitative approach was chosen in this study which aims to examine the problems and obtain a deeper meaning according to environmental conditions. There are several considerations that underlie the research approach, namely (1) the researcher intends to develop the concept of thinking, understanding the patterns contained in the data, seeing as a whole a situation, process, individual, and group and deciphering inductively naturalistic. (2) The researcher intends to analyze and interpret a fact, symptom, and event related to the ability of the principal in improving the quality of education in the context of space, time and situation as it is. (3) the field

of study of this research deals with the process and activities of achieving institutional objectives, in which an interaction of activities occurs between various components of education.

According to Moleong, qualitative research (2007) is "research that intends to understand the phenomenon of what is experienced by research subjects such as behavior, perception, motivation, actions, etc. holistically, and by way of description in the form of words and language in a special natural context and by utilizing various natural methods. Qualitative research is research that does not use mathematical, statistical or computer models. The research process begins with the basic assumptions and rules of thought that will be used in research"

The research design used in this study is multi-site. Multi-site studies were chosen in conducting this research because multi-site study research is one of the qualitative studies that can be used in terms of developing theories raised from several similar research settings, so that a theory can be transferred to a more general situation for presentation. wider. The design of a multi-site study is a qualitative research design involving several sites, places and research subjects. The research subject is assumed to have the same characteristics. Multi-site study research is exploring a problem with clearly detailed restrictions, having in-depth data retrieval, and including and describing various sources of information from places that have the same characteristics.

"Researcher" in qualitative research, is the main instrument in a study. Researchers act as planners, data collectors, analysts, and authors of research reports. In qualitative research the presence of researchers in the field is very important, because researchers will be able to deal directly with the phenomena that exist in the school, these phenomena can be directly and accurately obtained. In this case the researcher must be able to adapt and establish good communication with the people in the research location, so that every information and data that will be collected can be obtained in a complete and comprehensive manner.

## IV. DATA SOURCE

Data obtained from various sources that researchers consider very important in extracting information for this study, for data sources researchers categorize 2 sources, namely: (1) Main Source and (2) Complementary sources. The main sources are as follows:

a) Principal of SDN SN Pasar Lama 1 and SDN Sungai Miai Sungai 10

The main character in this study was the principal, so the researcher felt it was very important in extracting information and the data source of this study was the school principal concerned.

b) Teachers and staff staff of SDN SN Pasar Lama 1 and SDN Sungai Miai 10 Banjarmasin.

The two sources above are very important in extracting data sources for this study, because they are people who experience direct contact with the principal every day, of course, are very aware of the role and performance of principals in improving the quality of education in schools.

c) School Committee for Old Market SN SDN 1 and Miai Sungai 10 Elementary School.

The school committee is an intermediary or mediator between the school and the parents, so the presence of the school committee is an important factor in extracting the data in this study.

d) Parents of students at SDN SN Pasar Lama 1 and SDN Sungai Miai 10 Banjarmasin.

Parents of students are as consumers in the world of education, so the presence of parents in extracting this research data is very important in knowing the progress and improving the quality of education in schools

Complementary sources, namely documents: Documents in the form of photos, correspondence or written notes relating to the roles and factors that influence the effectiveness and success of the role of Principal SDN SN Pasar Lama 1 and SDN Sungai Miai 10 Banjarmasin in improving the quality of education in schools led and in it.

## V, RESEARCH INSTRUMENTS

The instrument is a tool that is used to do or help something related to the implementation of this research. The research instrument can also have meaning as data checking, data investigation, data collection activities, data processing, data analysis and data presentation objectively and systematically.

From the above definition, it can be concluded that research instruments are tools used in collecting data, examining data, investigating data and analyzing data information or problems, then presenting these data objectively and systematically with the aim of solving a problem and permalasahan or test the hypothesis so as to produce a conclusion that can be drawn from the final conclusion of the study. So, the final conclusion is that all the tools that can support a research conducted can be referred to as research instruments.

In the opinion of Arikunto (2010), "the data collection instrument is a tool that is chosen and used by researchers in collecting data so that the activity becomes systematic and facilitated by it, it can be concluded that the research instrument is a tool used to research collecting, processing data and presented in a systematic form to solve or test a hypothesis, so that the results / conclusions of the research that has been carried out can be taken ".

## VI. DATA COLLECTION TECHNIQUE

Quoting the opinion of Emzir (2008) "In qualitative research, data collection is carried out under natural conditions, primary data sources and more data collection techniques on participant observation, in-depth interviews, and documentation. In qualitative research data collection methods can be done with interview, observation and document techniques.

## VII. DATA ANALYSIS

According to Hamidi (2004: 16) "Data analysis is carried out from the beginning down to the location to collect data by paying in installments or saving information, reducing, grouping and so on to provide interpretation". Meanwhile, according to Sugiyono (2007: 298) Data analysis is "the process of systematically searching and compiling data obtained from the observation and documentation interview results".

The data consists of detailed descriptions of situations, people events, interactions, and behavior. In other words, data is a description of a person's statements about perspective, experience, or something about his attitude, beliefs and thoughts and excerpts of the contents of documents relating to a program.

The analysis used in this study are (1) Analysis of single site data and (2) Cross Site Data Analysis. The two components are as follows:

Single site analysis begins by sorting out all the data that has been collected from various techniques that have been implemented, namely interviews, observation and study of documents that researchers have recorded in the field notes. Miles and Huberman (Usman and Akbar, 2009: 88) describe the linkages between the three data reduction activities, data presentation and drawing conclusions or verification.

## VIII. FINAL RESEARCH FINDINGS

1. As an educator, the principal gives mental, moral, physical and spiritual guidance to his subordinates and actively includes them in upgrading / training outside the school to improve the quality of teacher teaching
2. The role as manager, the school principal empowers all education staff and non-school education, in participating in implementing the goals of the school's vision and mission. HR empowerment carried out in a coordinated manner according to its portion. And also other educational resource settings at school ...
3. As an administrator, the principal manages or coordinates all existing administrations in the school, all administrative facilities are assisted by two TU staff and several teachers appointed to handle them, in this case the principal is evaluator for the administrative completeness coordinator in his school .
4. As a supervisor, the school principal carries out guidance, guidance and guidance with great and high commitment to improve the teaching competencies of his subordinates, various supervision techniques are carried out, namely clinical supervision (class visits), individual talks from heart to heart, group discussions peer teachers, and workshops in schools to provide knowledge in carrying out teaching tasks
5. As a leader, the principal gives comfort to his subordinates in carrying out duties in school, by giving good examples of good personality, principals have authority that makes their subordinates respect and they can work with dedication without pres-

sure from the leadership.

6. As an innovator, principals are always looking for new ideas / ideas in improving the quality of education in schools, so that the schools they lead can produce generations of high achievers and also experience development and progress.
7. As a motivator, the principal creates a work atmosphere that is good and comfortable for his subordinates, in hopes of stimulating the work spirit of his subordinates to be more active and provide rewards to outstanding educational and non-education personnel

## IX. CONCLUSION

The role of school principals as educators, managers, administrators, supervisors, leaders, innovators, motivators, each has its own functions and objectives and is very very influential on improving the quality of education in schools, professional principals are principals capable of carrying out all these roles well and full of high dedication so that the improvement of the quality of education in schools can be achieved optimally.

## REFRENCES


[1] Arikunto, S. 2010. *Prosedur penelitian: Suatu Pendekatan Praktik*. (Edisi Revisi). Jakarta: Rineka Cipta.

[2] Emzir. 2008. *Metodologi Penelitian Pendidikan*. Jakarta: PT. Raja Grafindo Persada.

[3] Hamidi. 2004. *Metode Penelitian Kualitatif*. Malang: Universitas Muhamma-diyah Press.

[4] Mulyasa, E. 2007. *Menjadi Kepala Sekolah Profesional*. Bandung: Rosdakarya.

[5] Moleong, Lexy J. 2009. *Metodologi Penelitian Kualitatif*. Bandung; PT Remaja Rosdakarya Offset.

[6] Suriansyah, Ahmad. Aslamiah, Sulistiyana (2015). *Profesi Kependidikan "Persfektif Guru Profesional"*. Jakarta : PT. Raja Grafindo Persada

[7] Syafaruddin. 2002. Manajemen Mutu Terpadu dalam Pendidikan, Konsep, Strategi dan Aplikasi. Jakarta: Grasindo.

[8] Sugiyono. 2007. *Metode Penelitian Pendidikan*. Pendekatan Kuantitatif, Kualitatif dan R&D cetakan III. Bandung: Alpabeta.

# 4. Implementation of Early Childhood Character Education in the 2013 Curriculum

Susilawati, Erny Wahdini, Sutarto Hadi
Universitas Lambung Mangkurat, Banjarmasin, Indonesia

**ABSTRACT**

The purpose of this study is to describe the 2013 Curriculum in the (1) im- plementation of character education, (2) values, and (3) education strategy. Early Childhood Education is a form of education fundamental in the life of a child. In the 2013 Curriculum perspective, character education in early childhood integrated in Core Competencies 1 Spiritual Attitudes and Core Competencies 2 Social Attitudes. This study uses a descriptive qualitative approach to design multiple sites with data collected through interviews, observation, and documentation. This research uses a descriptive qualitative approach with a multi-site study design in the PAUD Islamic Integrated Al Khair Bara- bai and PAUD Negeri Pembina Barabai. Data collection techniques collected through interviews, observation, and documentation. To validate data using triangulation of sources, techniques, and time. The conclusion of the research is the 2013 curriculum is a source reference in the preparation of pro- grammed activities and habituation activities in addition to the curriculum characteristic of the institutions of each institution. The character values im- plemented are 18 from the government, Spiritual Attitudes and Social Atti- tudes. The character education strategy is carried out by the Foundation, the head, educators, educational staff, students, parents who are used through planning, implementation and evaluation.

**Corresponding author:*E-mail: suzybarabai@gmail.com

*Keywords: Character education, PAUD, 2013 curriculum*

## I. INTRODUCTION

Civilization tends to decline in a community when it's moral, honor, and character demoral- izes. These factors are responsible to obtain an orderly, safe, and prosperous society. Charac- ter education saves the decline of the moral val- ues of Pancasila and shapes one's personality as seen in a person's actions, towards good words and deeds.

According to Lickona, the quality of the character of a society is characterized by the quality of the character of its young generation, which can be an important indicator of whether a nation can progress or not. Lickona identified 10 signs of the character of the young genera- tion that are worth worrying about because it will make a nation sink into ruin. The ten signs are; (1) Increased violence among adolescents, (2) worsening use of language and words, (3) Strong peer-group influence in acts of violence, (4) Increased self-destructive behavior, such as drug use, alcohol, and free sex, (5) Increasingly obscured good and bad moral guidelines, (6) Declining work ethic, (7) Declining respect for parents and teachers, (8) Low sense of individ- ual and citizen responsibility, (9) Cultivating dishonesty, and (10) There are mutual suspi- cion and hatred between people (Megawangi, 2017).

The increasing level of drug users is also one of the problems of the Indonesian people. How much effort the government has done to socialize early on, arrest drug dealers and tighten border guarding that is prone to drug distribution. Various alternatives to overcome the moral crisis or character have carried out by the government and stakeholders, such as making laws and regulations, increasing the implementation, and law enforcement efforts. Besides that, to overcome moral or character crises is to carry out character education at every level of education. Every level of educa- tion is expected to create a conducive atmos- phere in the application of character education, which is by involving all components of educa- tion both institutions, families, communities, and related government.

Character education is one of the choices to overcome the moral degradation of the Indone- sian nation at every age, especially in early childhood. The implementation of character education in Indonesia is not only at age Elementary Schools to Colleges but from an early age, i.e. implemented in Informal Education or Family Education and non-formal education es- pecially in Non-formal Early Childhood Educa- tion Institutions. Early Childhood Education is a fundamental form of education in the life of a child and education at

this time will determine the survival of the child itself also for a nation. Character education at an early age can follow a certain pattern, namely an organized behavior, discipline, and standard or according to standards (Sudaryanti, 2012)

PAUD is a fundamental form of education in a child's life which is highly strategic in instil- ling positive character values. Schools as edu- cational institutions play an important role in the development of skills, character, attitudes, and teaching science to children (Ahmad, 2014). The character formation will be deter- mined not only by the strength of management in the relevant organizational units of the school. The strength of management is very de- pendent on the quality and strength of the prin- cipal as a leader (Suriansyah, 2015).

PAUD is the most fundamental education because child development in the future is largely determined by various meaningful stimulations given from an early age. Early childhood education must be planned in a ho- listic and integrated manner so that in the golden period the development of the child gets full stimulation, to develop his various poten- tials. Efforts can be made to develop this poten- tial through a structured education program. The component for structured education is the curriculum. The curriculum is defined as an ed- ucational design that outlines all learning expe- riences provided for students). In the study of philosophy, its values, and knowledge are inte- grated with educational actions (Suhaimi & Rinawati, 2018).

In 2013 the Curriculum of PAUD covered all aspects of development including attitude, reli- gious, moral, physical, cognitive, and emotional values. Furthermore, it structured the develop- ment of Core Competencies which comprises of spiritual and social attitudes. Educational suc- cess is determined by the foundation in learn- ing and its elements such as students, educa- tors, interaction, environment, and educational content (Salaisiah, Asniwati & Effendi, 2018).

PAUD Islam Terpadu Al Khair Barabai is an early childhood education institution which is in great demand by parents. This is proven from a large number of students irrespective of the exorbitant tuition fees. However, parents testified that they are often reminded by their children when they behave contrary to the be- haviors taught in PAUD institutions. For exam- ple, when parents eat or drink while standing, their children automatically reprimand them by reading the hadith related to its prohibition. Negeri Pembina Barabai is an early childhood education institution which is not popular in the city of Barabai. Also, it is a public school, af- fordable by parents and graduates emerge with outstanding character and readiness to further their education to other levels.

Based on the description above, the re- searchers chose PAUD Islam Terpadu Al Khair Barabai and PAUD Negeri Pembina Barabai as the study location. The purpose of this research is to determine and describe the: (1) Imple- mentation of the 2013 curriculum in character education, (2) Character values, and (3) the Strategies in both locations.

## II. MATERIAL AND METHODS

This study uses a qualitative descriptive ap- proach with multi-site re- search design and data collection techniques through interviews, observation, and documentation. Research time for one year. Data were analyzed from the process of research in the field carried out until the end of data collection using data analysis techniques proposed by Miles, Huberman & Huberman (2014).

The objects of observation consist of educa- tors, staff, students, par- ents, and learning activ- ities. The object of the interview is related to how the implementation of the 2013 Curricu- lum in character education, is implemented, and the strategy involved (Metroyadi, 2017). Observations were carried out directly by ob- serving the learning process at the PAUD Islam Terpadu Al Khair Barabai and Negeri Pembina Barabai with the habituation and behavior of all components including facilities and infra- structure. Furthermore, the Weekly Learning Implementation Plan (RPPM), (Daily learning implementa- tion plan) RPPH, Standard Operat- ing Procedures (SOP), institutional profile, vi- sion, mission, goals of the institution, adminis- trative structure, photo of activities, and other books are used to support character education (Sugiyono, 2017). Figure analyzes the Cross-Site Data Analysis used in this study.

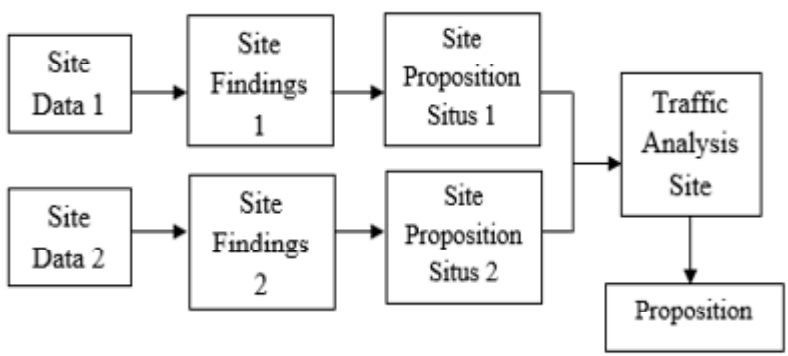



Figure 1. Cross-Site Data Analysis

## III. RESULTS AND DISCUSSION

This research was carried out at Terpadu Al Khair Barabai and Negeri Pembina Barabai based on a permit letter obtained from the Head of the Education Study Program of Early Childhood at Universitas Lambung Mangkurat Number: 059 / UN8.1.2.6.5 / SP on 31 August 2018. The data obtained from both institutions were compared in table 1 as follows:

Table 1: Comparison of Findings from Site 1 and Site 2

| No. | Research Focus | Data of Site 1 | Data of Site 2 |
|---|---|---|---|
| 1. | How is the implementation of the 2013 curriculum in character education in the PAUD Islam Terpadu Al Khair Barabai and the Negeri Pembina Barabai? | Programmed Activities<br>a. RPPM: Core Competencies (KI), Base competencies (KD) of 2013 Curriculum, Graduate Competency Standard of the Integrated Islamic School Network (SKL of JSIT)<br>b. RPPH: 5M, TERPADU<br>Habituation Activities<br>a. Routine Activities: SOP, Liaison Book, Habituation Book, Memorandum Syllabus<br>b. Spontaneous Activities: reminding students, giving appreciation<br>c. Exemplary: from educators and teachers<br>d. Conditioning: spatial planning, Muslim dress and, non-smoking area banners<br>e. Institutional Culture: SOP for education staff, 5S, and routine studies | Programmed Activities<br>a. RPPM: KI, KD of 2013 Curriculum, SKL of JSIT<br>b. RPPH: 5M<br>Habituation Activities<br>a. Routine Activities: SOP, Liaison Book<br>b. Spontaneous Activities: reminding students, giving appreciation<br>c. Exemplary: from educators and teachers<br>d. Conditioning: inside and outside spatial planning<br>e. Institutional Culture: 5S |
| 2. | How is the character value implemented in the 2013 curriculum perspective in Islam Terpadu Al Khair Barabai and Negeri Pembina Barabai? | a. JSIT: Faith and piety, manners, love of God, Apostles, Prophets, Companions, Prophet, Pillars of Faith, and Islam.<br>b. 18 character values: religious, honest, tolerance, discipline, hard work, creative, independent, democratic, curiosity, national spirit, love of the motherland, respect for achievement, friendly/communicative. love. peace, care for the environment, and society.<br>c. KI-1 Spiritual Attitude: observance of worship, gratitude, praying before and after activities, tolerance in worship.<br>KI-2 Social Attitudes: honest, discipline, responsible, polite, caring, confident, cooperation, accuracy, perseverance, etc. | a. 18 character values: religious, honest, tolerance, discipline, hard work, creativity, independent, democratic, curiosity, national spirit, love of the motherland, respect for achievement, friendly/ communicative, peace, love to read, and care for the environment.<br>b. KI-1 Spiritual Attitude: observance of worship, gratitude, praying before and after activities, tolerance in worship.<br>KI-2 Social Attitudes: honest, discipline, responsible, polite, caring, confident, cooperation, accuracy, perseverance, etc. |

| | | | |
|---|---|---|---|
| 3. | How is the strategy of implementing character education in the 2013 curriculum in the PAUD Islam Terpadu Al Khair Barabai and Negeri Pembina Barabai? | Character education is carried out by all teaching and education staff including students and parents. The strategies used are planning, implementation, and evaluation. | Character education is carried out by all teaching and education staff including students and parents. The strategy used is planning, implementation, and evaluation. |

Implementation of the 2013 curriculum in character education

The implementation of character education on sites 1 and 2 is carried out through the 2013 Curriculum which is integrated with the form of programmed and habituation activities. The programmed activities include RPPM and RPPH. While in the habituation activities, it is carried out in the form of routine, spontaneous, exemplary, conditioning, and institutional cul- ture. What distinguishes the two institutions is the existence of a unique curriculum in the form of a Graduate Competency Standard (SKL) from JSIT.

The implementation of character values for young children is carried out through pro- grammed and habituated activities, which are activities that are on the agenda and are de- signed in the syllabus of educators and learning tools, both in the short and long term, while ha- bituation is an activity carried out through rou- tine, spontaneous, exemplary activities, condi- tioning, and institutional culture.

On-site 1, the typical curriculum programmed activities are called the Graduate Competency Standard (SKL) of the Integrated Islamic School Network (JSIT) which are integrated through Basic Competencies (KD) and the learning process listed in the RPPH known asTERPADU. Therefore, in addition to containing the 5M component which consists of observation, asking, gathering information, reasoning, and communicating, it also contains a TERPADU component which comprises an explanation, exploration, response, habituation, affirmation, worldly and ukhrawi. Furthermore, habituation activities include routine, spontaneous, exemplary, conditioning, and institutional culture.

According to (Arsyad, 2010) character edu- cation can also be a hidden curriculum, such as time management, ethics, and integrity, think- ing ability, willingness to learn, commitment, desire for success/motivation, strong en-

ergy impulse / very high spirit, oral communication, creativity, analytical skills, can deal with stress, self-management and take responsibility, prob- lem-solving, cooperation, adaptability and wis- dom, teamwork, ability to be a good listener.

Based on observations and interviews sup- ported by documentation, it is obtained an overview of how the teacher's strategy in inte- grating character education in each learning, even outside of learning as done by the teacher in carrying out learning in the classroom and outside the class always shows the appropriate attitudes, behaviors, and actions with the norms that apply in schools and society consist- ently. At the exemplary point, the teacher needs to carry out activities for the class, by giving ex- amples and improving learning outcomes for the proper developments of religious and moral values to help distinguish between good and bad actions. The use of audio-visual media tends to improve the development results of children's religious and moral values. There- fore, to create active and enjoyable learning, the quality of learning outcomes needs to be improved (Metroyadi, 2017).

In this habituation, site 1 uses the Customi- zation Book and Memorandum Syllabus, to structure a variety of banners which supports the planting of the character and culture with the existence of SOPs and routine compulsory studies for each teaching and education staff. While site 2, uses the 2013 Curriculum as a ref- erence in the preparation of learning activities programs.

Character values implemented in the 2013 curriculum perspective

Character values are applied based on Spiritual Attitude which consists of observance of worship, gratitude, praying before and after activities, tolerance in worship, as well as Social Attitude which consists of honest, discipline, responsibility, courtesy, care, confidence, cooperation, accuracy, and perseverance in the development of cultural education. Similarly, the national character made by the Ministry of National Education consists of religious, honest, tolerance, discipline, hard work, creative, independent, democratic, curiosity, the spirit of nationalism, love for motherland, respect for achievement, friendly communication, peace, love to read, care for the environment, and social responsibility. However, there are more character values which are applied on site 1, besides those mentioned above from the SKL of JSIT such as Faith and God-fearing, manners, love of God, Prophet, Companions, as well as, Pillars of Faith and Islam.

From the explanation above, it can be con- cluded that the inculcation of character values that are first accustomed to learners are reli- gious character values such as daily Islamic et- iquette such as eating and drinking etiquette, speaking etiquette, courtesy to dressing, cour- tesy of dressing, sleeping decency, eternity to- wards others, eternity towards parents, man- ner towards Allah's creations such as plants and animals through memorization of hadith, prayer, and short suras. This has a very signifi- cant impact on the character of students be- cause it is done repeatedly every day so that it is formed into positive habits that become awareness for students and can reprimand oth- ers when they are not following the characters that have been taught and familiarized.

As the results of the study (Safutri, et al., 2018) which with one of the variables in the de- velopment of children's independence through the practical method of direct activities which shows the results of research that learning ac- tivities to develop children's independence through direct practice methods have been im- plemented well so that the average class reaches very active and classic criteria are in the very active category. Therefore, it is very important to use hands-on methods so that children are actively involved and gain direct experience through exemplary examples of the environment around children so that children can be able to follow them. Because one's suc- cess is determined by 20% of his hard skills and 80% percent of his soft skills. Following what was said by (Sukriani et al., 2017) that the qual- ity of education has been largely determined by the character of students. Therefore, the focus on character development must be prioritized.

Strategies for implementing character edu- cation in the 2013 curriculum perspective

Education in the perspective of the national education system forms a whole person, that is, a person who is both character and intelligent (Suriansyah, 2015). Education in the perspec- tive of the national education system forms a whole person, that is, a person who is both character and intelligence. The creation of quality education requires teachers and profes- sional education staff with the hope of produc- ing graduates who have a strong character, respecting cultural diversity as the glue of na- tional integration, accompanied by mastery of basic life skills (soft skills) and the foundation of mastery of science and technology (hard skills) that necessary for their duties as individ- uals in society, upholding ethical values and be- ing responsible for the welfare of the

nation and the motherland (Brandsford & Darling, 2005; Gardner, 2006). Character education needs to be done by all educators and educa- tion personnel as well as the involvement of parents which is very important because the strategy is part of the planning, while planning is part of success. This strategy is not only im- plemented in PAUD institutions but must in- volve the participation of parents so that edu- cation is not only the responsibility of the institution but must continue at home to create syn- ergy and cooperation between educational in- stitutions and parents in the education process of students.

Character education at sites 1 and 2 was carried out by all teaching and educational staff including the head, staff, students, and parents, through planning, implementation, and evaluation.

The development of attitude competence as well as the development of other competencies must be planned and implemented as thor- oughly as possible so that the attitude that is built-in children is as expected. The development of a well-planned attitude competency will encourage the formation of character from an early age.

The principles that need to be considered in developing planning are: (1) The competency formulation in teaching preparation needs to be clear. The more concrete it is, the easier it is observed and the more precise the activities that need to be carried out to shape the competency. (2) Teaching preparation needs to be simple, flexible, and carried out in learning activities and the formation of student competencies. (3) Activities arranged and developed in teaching preparation need to be supported following the established competencies. (4) The developed teaching preparation needs to be complete and comprehensive, with clear achievements. (5) There needs to be coordination between the components of implementing school programs, assuming the learning is carried out in teams or moving classes *moving class* (Mulyasa, 2004). The planning referred to is the preparation of the curriculum which is then integrated into the educational calendar, semester program, RPPM, and RPPH.

As a term, making a plan is part of success. Careful planning arranged into learning tools by incorporating values character in curriculum development. The curriculum is the key to the successful implementation of education character in the 2013 early childhood curriculum. Related to the preparation curriculum, this planning is carried out by all teaching staff and education personnel.

All components of the institution play an ac- tive role in instilling the

character of students. Therefore, all parties need to work together by activating communication with one another di- rectly or indirectly (Whatsapp group). Commu- nication is an activity that is always carried out by everyone because it is needed for humans as social beings. It is the heart of life in organiza- tions, the key to successful team effort (Suri- ansyah, 2014).

The implementation of character planting is carried out by all components of the institution, starting with the example and starting from simple things and carried out continuously every day. Exemplary is the most absolute element to do changes in life behavior, in prepar- ing and forming children's spiritual and social morals. Therefore, the best example in the view of the child to be imitated in behavior and his manners are etched in juwa. This example is appropriately used to instill children's charac- ter and social values. That is, advice that is not accompanied by exemplary like the proverb brings sea salt to marinate the sea, more work is wasted than the benefits. Habituation, in essence, contains experience. Habit is something that is practiced. Therefore, the essence of ha- bituation is repetition.

According to the Ministry of National Edu- cation (2010), character education is every- thing something the teacher does, which can in- fluence character learners. Psychologically and socially culturally the formation of character in an individual is a function of the full potential of the human individual (cognitive, affective, connective, and psychomotor) in the context of sociocultural interactions (in family, school, and community) and lasts a lifetime. Evaluation of 2013 Curriculum learning related to the im- plementation of character education on sites 1 and 2 is conducted on a daily, weekly, and monthly basis, before the end of the semester with the distribution of student report cards. These progress reports are independently car- ried out by the teacher, based on daily notes in the contact book and anecdotes. Both sites also provide simple rewards, as a form of teacher appreciation to students for their efforts to be better in all aspects.

The evaluation includes various steps, namely data collection on children's develop- ment and learning, determining the importance of the program in considering program objec- tives, incorporating information into plans, and presenting findings. Assessment of children's progress is integrated with the curriculum and teaching. In the PAUD program, various proce- dures are used to (1) Design instructions for each child and group. (2) Communicate with the child's family. (3) Identifying children that need special treatment or

intervention. (4) In- forming the development of the program (Santi, 2009).

On-site 1, the task was evaluated by the deputy head of the curriculum to lead and sub- sequently conduct supervision and coach the preparation of learning tools. While on-site 2, it is called the curriculum team with a similar task as site 1.

The cross-site data analysis results are seen in the following explanation. This research has presented findings data in the PAUD Islam Terpadu Al Khair Barabai and Negeri Pembina Barabai. To conduct a cross-site analysis, the researcher explained the conclusions of the propositions from both sites.

Proposition conclusions of site 1

Based on the results of interviews, observa- tions, and documentation, conclusions were drawn on the character values implemented by PAUD Islam Terpadu Al Khair on the Graduate Competency Standard of the Integrated Islamic School Network. The character education which integrates the values of the government and Islamic values becomes the basis of inform- ing the vision, mission, goals, and curriculum of the institution. Educational Institutions aim to graduate children with character, to pilot edu- cation institutions using the Integrated Islamic School Network. The curriculum is integrated through programmed and habituation activi- ties such as RPPM which include KI, KD, and SKL from JSIT. RPPH uses the 5M method which consists of observation, asking, information gathering, reasoning, and communication fol- lowing the 2013 Curriculum and TERPADUwhich explains, explores, responses, habituates, affirms, worldly, and ukhrawi, following SKL of JSIT. The habituation activities consist of SOP, Liaison Book, Memorandum Syllabus, spontaneous activities which consist of stu- dents, educators, spatial planning, dress banners Muslims, non-smoking area banners, and the existence of institutional culture. The JSIT distinctive curriculum emphasizes religious values as a basis for the cultivation of children's character, such as research on the religion- based model implemented by Islamic schools which shows that all components including parents carry out religious-based character ed- ucation, thereby, making it a real example for all students (Celia, Suriansyah & Asniwati, 2018)

When a child has Islamic characteristics with a foundation of faith they tend to learn how to respect other people, irrespective of their religion. Teachers added the following strategies to expand tolerance in children, namely (1) good characters, 2) nature of reli- gious tolerance; (3) a stimulus for the child to think of good qualities; 4) provides a stimulus for religious tolerance, 5)

makes the child feel its benefits (Zain, Saleh & Noorhapizah, 2018). Character values that are implemented based on the JSIT curriculum are faith, piety, manners, love of God, Apostles, Prophets, Com- panions of the Prophet, Pillars of Faith, and Is- lam. Besides, the character values implemented are as follows: religious, honest, tolerance, dis- cipline, hard work, creative, independent, dem- ocratic, curiosity, national spirit, love of the motherland, valuing achievement, being friendly/communicative, peace-loving, fond of reading, caring for the environment and soci- ety. KI-1 consists of the following Spiritual Attitude: observance of worship, gratitude, praying before and after activities, and tolerance. While KI-2 consists of the following social Attitudes: honesty, discipline, responsibility, politeness, caring, confidence, cooperation, accuracy, diligence, and others following competencies in learning.

Strategies used in the Implementation of Character Education of PAUD Islam Terpadu Al Khair is carried out by all teaching staffs includ- ing foundations, heads, educators, students, and parents through planning, implementation, and evaluation. Planning is a form of effort used to compile a curriculum managed by the depu- ty's head in the form of a set of learning includ- ing RPPM, RPPH, and SOP. Besides, its imple- mentation requires synergy from all compo- nents of the institution to achieve educational goals to the maximum. The evaluation forms also vary for students in the form of anecdotal records, daily, weekly or monthly assessments and reported to parents through contact books and report cards.

Proposition conclusions of site 2

Character values implemented by PAUD Negeri Pembina are sourced from the 2013 Curriculum. It is the basis for forming the vi- sion, mission, goals, and curriculum of the insti- tution. The purpose of PAUD Negeri Pembina's education is to develop the ability of knowledge, skills, spiritual, social, and emo- tional for children to acquire a bright future.

The 2013 curriculum which is integrated through programmed activities and habitua- tion activities was used. This consists of pro- grammed activities such as RPPM which in- clude KI and KD. While RPPH uses the 5M method which consists of observation, asking questions, gathering information, reasoning, and communication. The habituation activity consists of routine (SOPs, Liaison Books), spon- taneous (reminding students, giving apprecia- tion), exemplary (all education staff), condi- tioning (spatial planning), and the existence of institutional culture activities (5S, religious tol- erance).

The character values implemented are reli- gious, honest, tolerance, discipline, hard work, creative, independent, democratic, curiosity, national spirit, love of the motherland, valuing achievement, friendly/communicative, loving peace, fond of reading, environment, and social responsibility. The 2013 curriculum consists of KI-1 and KI-2, where KI-1 is the Spiritual Atti- tude which consists of observance of worship, gratitude, praying before and after activities, tolerance in worship. KI-2 comprises of Social Attitudes as follows: honesty, discipline, re- sponsibility, politeness, caring, confidence, co- operation, accuracy, perseverance, and others following competencies in learning. Character education in PAUD Negeri Pembina is carried out by all teaching and educational staff includ- ing students and parents, using the planning, implementation, and evaluation strategy.

Planning is an effort used to compile a cur- riculum in the form of a set of learning such as RPPM, RPPH, and SOP. It is also managed by the curriculum team.

Its implementation requires synergy from all components of the institution to achieve ed- ucational to the maximum.

The evaluation forms which also vary for students are in the form of anecdotal records, daily, weekly or monthly assessments and re- ported to parents through contact books and report cards.

Cross-site analysis

Cross-site analysis in this research is based on the results of the above research findings. The implementation of early childhood character education from the perspective of the 2013 curriculum in the PAUD Islam Terpadu Al Khair Barabai and Negeri Pembina Barabai shows a change in the character planting of children. Especially when the institution combines the 2013 curriculum with the character with changes and updates to the concept or outlook on education. Important points are obtained for young children based on Islamic values. After determining the basic competencies of the 2013 curriculum, another important component of Islamic values were added to the advantage of PAUD Islam Terpadu Al Khair Barabai.

As earlier explained, the nature of imple- menting the curriculum results and quality changes in student learning fit the educational goals. This means that curriculum implementa- tion is a process of change to obtain results that are close to achieving the ideal educational goals. Therefore, all curriculum work, from the design, implementation, and evaluation is a cy- cle of change

(Ansyar, 2015).

Therefore, this cross-site analysis produces the following:

Character values implemented by the PAUD Islam Terpadu Al Khair are sourced from the 2013 Curriculum and the Graduation Standards for the Integrated Islamic School Network. Character education which integrates the values of the government and Islamic values becomes the basis of informing the vision, mission, goals, and curriculum of the institution. Educational Institutions aim to graduate children with good characters to pilot education institutions.

The curriculum used is the 2013 Curricu- lum is from the Integrated Islamic School Network and integrated through programmed and habituation activities. The programmed activities such as RPPM include KI, KD, and SKL from JSIT. While the RPPH used the 5M methods which consist of observation, asking ques- tions, gathering information, reasoning, and communicating, which is following TERPADU consisting of explanation, exploration, response, habituation, affirmation, worldly and ukhrawi following SKL of JSIT. The habituation activities consist of routine (SOP, Liaison Book, Habituation Book, Memorandum Syllabus), spontaneous (reminding students, giving appreciation), exemplary (from all educators), conditioning (spatial planning, dress banners Muslims, non-smoking area banners) and the existence of institutional culture activities). Character values implemented by PAUD Negeri Pembina are sourced from the 2013 Curriculum which is the basis for forming the vision, mission, and institutional goals. The purpose of PAUD Negeri Pembina's education is to develop knowledge, spiritual, social, and emotional skills for children to acquire a bright future.

The 2013 Curriculum which is integrated through programmed activities and habituation activities was utilized. Programmed activities such as RPPM include KI and KD. Where RPPH uses 5M which consists of observation, questioning, gathering information, reasoning, and communication. The habituation activities consist of routine (SOPs, Liaison Books), spontaneous (reminding students, giving appreciation), exemplary (from all educators and education staff), conditioning (spatial planning), and the existence of institutional culture activities (5S, religious tolerance). Character values are ap- plied based on the 2013 Curriculum and the de- velopment of culture created by the Ministry of National Education. However, more character values are applied in the PAUD Islam Terpadu Al Khair Barabai, in addition to the above men- tioned that are

sourced from the SKL of JSIT which is a curriculum characteristic of the institution. The character values are JSIT which comprises of Faith and piety, manners, love of God, Apostles, Prophets, Companions, Pillars of Faith and Islam. Besides, the character values are religious, honest, tolerance, discipline, hard work, creative, independent, democratic, curi- osity, national spirit, love of the motherland, re- spect for achievement, friendship/communica- tion, peace, love to read, care for the environ- ment and social responsibility. KI-1 Spiritual Attitude includes: observance of worship, grat- itude, praying before and after activities, toler- ance in worship. While the KI-2 Social Attitudes consists of honesty, discipline, responsibility, politeness, care, confidence, cooperation, accuracy, perseverance, etc.

Character education in the PAUD Islam Terpadu Al Khair Barabai and Negeri Pembina Barabai is carried out by all teaching and edu- cation staff including students and parents us- ing the planning, implementation, and evaluation strategy.

Planning is an effort to compile a curricu- lum in the form of a set of learning including RPPM, RPPH, and SOP. This is managed by the deputy's head called the curriculum team with both sides conducting the implementation, de- mands, and components value for educational goals to be achieved. Similarly, in the evalua- tion stage, the two sites also carry out various forms of analysis for students in the form of an- ecdotal records, daily, weekly and monthly as- sessments which are reported to parents as contact books and report cards.

## IV. CONCLUSION AND RECOMENDATION

Based on the discussion of character imple- mentation in education using the 2013 Curric- ulum in the PAUD Islam Terpadu Al Khair and the Negeri Pembina, the following conclusions are obtained:

In the implementation of character educa- tion, the 2013 Curriculum is used as a reference for the preparation of activities consisting of programmed activities and habituation activi- ties for each institution.

The implemented character values are faith and piety, manners, love of God, Apostles, Prophets, Companions, Pillars of Faith, and Is- lam. Furthermore, the character values imple- mented are as follows: religious, honest, toler- ance, discipline, hard work, creative, independ- ent, democratic, curiosity, national spirit, love for motherland, valuing achievement, friendly, peace-

loving, fond of reading, caring for the en- vironment, and social responsibility. Besides, the 2013 Curriculum consists of KI-1 comprises of Spiritual Attitude such as observance of wor- ship, gratitude, praying before and after activities, tolerance in worship. While KI-2 com- prises Social Attitudes such as honest, disci- pline, responsibility, politeness, caring, confi- dence, cooperation, accuracy, perseverance, and others following competencies in learning. The character value implemented is deter- mined by the curriculum used.

The strategy used in the Implementation of Character Education of PAUD Islam Terpadu Al Khair is carried out by all teaching and educa- tional staff including the Foundation, heads, students, and parents, using the planning, implementation, and evaluation strategies.

Suggestions for educational institutions are to further develop and improve the implemen- tation of the 2013 Curriculum in instilling the character of students. All components of the in- stitution including parents must work together to support the vision, mission, and goals of the educational institution unit by starting with an example that is consistent in all aspects of daily life from even the smallest things.

## ACKNOWLEDGMENT

The authors are grateful to the head of the study program and the secretariat of Masters in Teacher Education of Early Childhood Educa- tion, PAUD IT Al Khair Barabai, and Pembina Barabasi. In addition to the prayers and sup- port of friends and loved ones, may *Allah Sub- hanahu Wa Ta 'ala* give more kindness to yours. *Jazakumullahu khairan.*

## REFERENCES

Ahmad, K. (2014). Penerapan pendidikan karakter, pendekatan SESOSIFIT (spiritual, emosional, sosial, intelektual, fitrah) melalui layanan bimbingan dan konseling. *Tarbiyah Jurnal Ilmiah Pendidikan, 3*(1), 45-49. Retrieved from http://eprints.unlam.ac.id/id/eprint/277

Ansyar, M. (2015). *Kurikulum: Hakikat, Fondasi, Desain & Pengembangan.* Jakarta: Kencana.

Arsyad, A. (2010). *Strategi implementasi pendidikan karakter bangsa di perguruan.* Bogor: Balitbangdiknas.

Brandsford, J., & Darling, H. (2005). *Preparing teachers for a changing word: what teachers should learn.* San Fransisco: CA: Jossey-Bass.

Celia, C., Suriansyah, A., & Asniwati. (2018). The model of religion-based character education (multi-site integrated islamic PAUD Sabilal Muhtadin and PAUD islam Mawaddah Banjarmasin, Indonesia). *European Journal of Education Studies, 3*(7), 1-13. Retrieved from https://www.oapub.org/edu/

Gardner, H. (2006). *Five minds for the future.* Boston: Harvard Business School Press.

Kemendiknas. (2011). *Panduan pelaksanaan pendidikan karakter.* Jakarta: Badan Penelitian dan Pengembangan. Pusat Kurikulum dan Perbukuan.

Lickona, T. (2008). *Educating for character how our school teach respect and responsibility.* New York: Bantam Books.

Megawangi, R. (2017). *Menyemai benih karakter.* Depok: Indonesia Heritage Fondation.

Metroyadi. (2017). Upaya Mengembangkan Aspek Nilai-Nilai Agama dan Moral dalam Membedakan Perbuatan Baik dan Buruk Menggunakan Model Examples Non Examples dengan Variasi Media Audio Visual pada Anak Kelompok B di TK Aisyiyah Bustanul Athfal 31 Banjarmasin. *Sagacious Jurnal Ilmiah Pendidikan dan Sosial, 4*(1), 7-12.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative Data Analysis A Methods Sourcebook.* USA: Sage Publications.

Mulyasa. (2004). *Menjadi guru profesional.* Bandung: Remaja Rosdakarya.

Poernamawijaya, L., Sulaiman, Suriansyah, A., & Dalle, J. (2018). Contribution on supervision of supervisor, principals motivation, kindergarten teacher performance to improving the kindergarten quality in west Banjarmasin, Indonesia. *European Journal of Alternative Education Studies, 3*(2), 129-146.

Safitri, M. E. (2018). Development of Child Independence Through Model Picture and Picture, Examples Non

Examples Model and Practical Method Directly Activities of Learning Practical Life in Group B Kasih Ibu Kindergarten, Banjarmasin, Indonesia. *European Journal of Education Studies, 5*(7), 64-80. Retrieved from https://www.oapub.org/edu/

Salasiah, Asniwati, & Effendi, R. (2018). Instilling Character Values in Early Childhood in The Perspective of Curriculum and Parenting (Multi-Site Study in PAUD Islam Sabilal Muhtadin and PAUD Mawaddah, Banjarmasin, Indonesia). *European Journal of Education Studies, 5 (7).*, 41. Retrieved from https://oapub.org/edu/index.php/ejes/article/view/210 0/4736

Santi, D. (2009). *Pendidikan Anak Usia Dini: Antara Teori dan Praktik.* Jakarta: Indeks.

Sudaryanti. (2012). Pentingnya pendidikan karakter bagi anak. *Jurnal Pendidikan Anak, 1*(1), 11-20. doi: https://doi.org/10.21831/jpa.v1i1.2902.

Sugiyono. (2017). *Metode penelitian kualitatif: untuk penelitian yang bersifat eksploratif, enterpretif, interaktif dan konstruktif.* Bandung: Alfabeta.

Suhaimi & Rinawati, Y. (2018). Management of Character Education Curriculum at Vocational High School 2 Kandangan. *Advances in Social Science. Educational and Humanities Research*, 272-274. doi:https://doi.org/10.2991/iccite-18.2018.59

Sukriani, Huda A. Y. M., Arifin, I., & Suriansyah, A. (2017). The Implementation of The Islamic Schools Resources Total Quality Management in Banjarmasin, Indonesia. *Journal of Social Sciences (COES&RJ-JSS), 6*(1), 125-138.

Suriansyah, A. (2014). Hubungan Budaya Sekolah, Komunikasi, dan Komitmen Kerja Terhadap Kinerja Guru Sekolah Dasar Negeri. *Cakrawala Pendidikan*, 358-367.

Suriansyah, A. (2015). Strategi Kepemimpinan Kepala Sekolah, Guru, Orangtua dan Masyarakat dalam Membentuk Karakter Siswa. *Cakrawala Pendidikan, Th. XXXIV, No. 2*, 234-247.

Zain, A., Saleh, M., & Noorhapizah. (2018). Strategy for the Development of religious worship and religious tolerance at Widya Dharma PAUD in Banjarmasin City, Indonesia. *European Journal of Education Studies, 3*(2), 88-106. Retrieved from https://www.oapub.org/edu/

# 5. Development of Cognitive Aspects of Children in Matching Numbers with Number Symbols using a Combination of Demonstration, Make a Match Models Assisted by Audio Visual Media

Asrul Hidayat, Sutarto Hadi, Darmiyati
Lambung Mangkurat University, Banjarmasin, Indonesia.

**ABSTRACT**

The purpose of this study was to describe teacher activities, children's activities and the development of children's cognitive abilities in matching numbers with number symbols using a combination of Demonstration, make a Match model, assisted by Audio-Visual Media in group B of TK RA Citra Islami Banjarmasin.This study uses a qualitative approach with a type of classroom action research (CAR). Sources of data in this study were teacher and child group B of TK RA Citra Islami Banjarmasin located on Jalan Kelayan B Komplek 10 Gang H. Thaberi RT. 13 Banjarmasin. The research instrument used by researchers to retrieve data is observation.The results of this study illustrate that the teacher's activities have been carried out according to the steps that have been set with very good criteria. Child activity increases in each cycle with very active criteria. Development of cognitive aspects of children in matching numbers with number symbols using a combination of Demonstration, make a Match model, assisted by Audio-Visual Media in group B TK RA Citra Islami Banjarmasin has improved with the criteria of developing very well.The suggestion of this study is expected to be a guideline in learning activities using the combined Demonstration, Make a Match model, assisted by Audio-Visual Media in an effort to improve the quality of learning on cognitive aspects and provide input for subsequent researchers to be able to increase creativity in carrying out the research process.

## I. INTRODUCTION

Learning activities can not be separated from the role of teachers and students because both components are very important in the learning process. (Suriansyah & Aslamiah, 2015). The role of educators is very important, because as individuals who are able to carry out educational actions in one educational situation in order to achieve educational goals. The teacher becomes one of the things that assesses the implementation of a learning strategy in the classroom. Creative, professional and exciting teachers are required to have developing skills approach and choose effective learning methods (Mulyasa, 2015).

Early childhood can also be referred to as the golden age. Children experience rapid growth and development during the golden age. (Santrock & John, 2007) states that children aged 4 to 6 years of brain development are almost like adults. This will affect the response from the environment. The Golden Age concept is reinforced by the fact found by Neurologists who claim that when babies appear they carry 100-200 billion neurons or nerve cells that are ready to work between cells. At the age of children reaching the age of 3 years, the development of the mind network reaches 80%. Whereas more and more adult children the development of the child's mind tissue is slowing down due to the increasing network of the mind.

The golden age only takes place 1 time throughout the human life span itself. This indicates how miserable a family is when it ignores the golden age of a child that is held in the early childhood education stage. Positive stimuli can give experience to children so that the development & performance of the brain works optimally.

The fact that was found at RA TK Islamic Image Banjarmasin in Group B that the cognitive aspect growth in early childhood is not maximal, to the extent that children find it difficult to compare numbers with symbol numbers that occur at this time there is still no type of playing work in children that have not shown a real object which is the topic of the theme discussion that was carried out. (Safitri, Ibnu Ahmad & Saleh, 2018). This makes the information obtained by the child still not clear enough and still not real.

By looking at the atmosphere, the information obtained by the child cannot be received. The impact of these matters is that children cannot recognize and separate the numbers five (5), six (6), eight (8), and (9) and

do not understand how to compare the number or not a few objects with the number stage.

Data in the 2015-2016 training year out of 15 children, there were 4 children who could recognize and compare numbers with the number stage or "Develop according to expectations" (BSH), 4 children began to recognize and compare numbers with the number stage or "Start to Develop" (MB) and 6 children still cannot recognize and compare numbers with number or "Not Developing" (BB). The 2016-2017 training year data from 14 children, there were 2 children with the criteria of "Very Good Developing" (BSB), 2 children with the criteria of "Developing according to Expectations" (BSH), 7 children with the criteria of "Developing" & 3 children with the criteria of "Not Developing" (BB) in recognizing and comparing numbers with number stages. Whereas for the training year 2018-2019, from 16 children, only 3 children were able to recognize and compare numbers with number symbols or "Develop according to expectations" (BSH), 5 children began to recognize and compare numbers with number symbols or "Start Developing "(MB) and the remaining 8 children cannot recognize and match numbers and symbol numbers or "Not Developing" (BB). The fact is that at this time because it was provoked by the growth of the era which increasingly accelerated until the objects needed by children for direct monitoring even faded to the point that the information obtained by children was increasingly minimal. Until now, children are not enough to get the opportunity to work on direct experience of real objects from the work carried out. If the matter is not cared for continuously, the children will not be able to know the object actually from the empirical thing it does.

This will have a negative impact on children, the weight of the quality of education itself for the future. Whereas in the activity, children themselves should be the main objects in working on activities, active children are not teachers. Thus, according to the above problem the analysis of the researcher to overcome the problem can be carried out using a combination of demonstration models, make a match by assisting audio-visual media such as videos about numbers and symbol numbers to something that the child sees as real. Of the many models, it is desirable cognitive children can increase in comparing numbers with symbol numbers and develop as optimally as possible.

Strategies to overcome cognitive problems in comparing numbers with symbol numbers with a combination of models. The combination itself combines a number of models in a way or medium.

From the description of the background of the problem, the researchers were most interested in analyzing "Cognitive Development of Children in Matching Numbers with Symbols of Numbers Using a Combination of Demonstration Models, Make A Match Assisted by Audio-Visual Media in Group B of RA Islamic Image Banjarmasin.2.

## II. METHODOLOGY

This research approach uses a qualitative approach. Qualitative data, namely data in the form of sentence information that reflects the expression of children in connection with the level of understanding of a knowledge (cognitive), or student attitudes toward new ways of learning (affective), children's activities following lessons, attention in learning, beliefs self, spirit of learning, and the like, can be examined qualitatively (Kunandar, 2012).

The qualitative approach emphasizes the analysis of the processes of inductive thought processes that are related to the dynamics of the relationships between observed phenomena, and always with scientific logic. Qualitative approaches are meaningless without using support from quantitative data but are emphasized in the depth of the formal opinion of the researcher in responding to the problems faced (Gunawan & imam, 2013).

This type of research is Classroom Action Research (CAR). Where is Classroom Action Research (CAR)? Based on information from Ebbut & Hopkins (Kunandar, Classroom Action Research, 2012) is a systematic study of efforts to improve the practice of education by teachers by working on actions in learning, according to their reflections on the results of these actions.

This study uses Classroom Action Research (CAR) by working on actions in an effort to improve the cognitive aspects of the child in comparing numbers and symbols to the point that the cognitive aspects of the child develop as they should. Research into action classrooms (classroom action research) has a very urgent and strategic role to increase the quality of learning when implemented properly and correctly.

The event/event from this study was carried out in kindergarten RA Kindergarten Islamic image of Banjarmasin in Group B which was addressed

at Jalan Kelayan B Komplek 10 Gang H. Thaberi RT. 13 Banjarmasin. The Kindergarten room consists of 4 rooms, consisting of 2 rooms in group A and 2 rooms in group B. This study aims to explore the strategies & teaching techniques of teachers in developing cognitive aspects of children in comparing numbers with number symbols using a combination of demonstration models and models. make a match & audiovisual media. Researched Factors are teacher, two children and the results of children's cognitive development that are dominant to the kindergarten.

## III. FINDING AND DISCUSSION

Based on the findings obtained through the implementation of the teacher activity learning plan, children's activities, and the results of children's skills at each of the 1st meeting, 2nd meeting, 3rd meeting and 4th meeting, the following matters can be determined:

a. Teacher Activity

Based on the data from the above research results, the use of the demonstration model combined with the make a matching model assisted by audio - visual media in the B TK RA group Islamic image has been successful in increasing the learning outcomes of children in group B TK RA Citra Islami. It can be seen from the score that continues to grow to start from the first meeting score of 22 with the fairly good criteria of the second meeting of the score 25 with the criteria of the third meeting the score 28 with good criteria, and the fourth meeting score 33 with the best criteria.

Associated with the lesson on developing cognitive aspects in comparing numbers with number symbols to the point that it can be decided that at the meeting the teacher's activities in the implementation of learning have obtained optimal results.

The teacher's activity increased in each meeting because the teacher was able to master the learning model applied by the teacher, namely the demonstration model combined with the assisted make a matching model audiovisual media & even this is caused by reflection at the end of each meeting and can be corrected at the next meeting (Suriansyah, 2015).

In accordance with the applied indicators, the teacher's activities are said to be successful in implementing the demonstration model combined with the make a matching model assisted by audio-visual media when the teacher's

activity gets the best criteria with a value range of 30-36. Thus, indicating that the teacher has been able to carry out learning by using the demonstration model combined with the make a matching model assisted by audio-visual media as expected.

There are still a number of activities in the 1st & 2nd meetings which have not been maximally carried out, including in the work aspects. The teacher asks the child to listen to the demonstration and analyze it. got a score of 2.

The process of doing reflection so that the teacher engages all children in working on reflection on learning. Meeting 2, meeting 3 & meeting 4 are carried out repairs so that there is an addition in every aspect. The teacher always strives to increase the quality of learning by using the demonstration model combined with the make a matching model assisted by audio-visual media so that the teacher can add to the child's learning outcomes. Then a teacher tries to be able to make the atmosphere & learning environment pleasant for children. Good learning can help improve children's activities & children's learning outcomes because the success of teachers in learning work will support children's success in learning.

The teacher has mastered the learning model & media applied because the teacher uses the demonstration model combined with the make a matching model assisted by audio-visual media & even this is caused by a reflection at the end of each meeting & can be corrected at the next meeting.

2. Child Activities

Based on observations of children's activities taking part in meeting 1, meeting 2, meeting 3 and meeting 4, the comparison of observational results of learning work shows that children's activities from meeting 1 to meeting 4 are witnessed from the criteria in meeting 1 with a percentage of classical 45% classified as criteria quite active, at meeting 2 with a percentage of 65% with active criteria, at meeting 3 with a percentage of 75% with active criteria, and at meeting 4 with a percentage of 86% with the most active criteria.

Increasing children's activities have begun to be active in learning work. This indicates that children's activities have begun to take part in learning work using the demonstration model combined with a matching model assisted by audio-visual media, but there are still a number of children who are

not active enough and are quite active in participating in learning work.

This indicates that the results of the research on children's activities on children's attention in paying attention to the teacher's explanation, analyzing the picture, the courage of the child inside doing learning & motivation in comparing images have been maximally overall. (Purwanti et al., 2018).

This result was obtained because using the demonstration model combined with the make a matching model assisted by audio-visual media has been applied well for children & children who have been able to carry out well, this matter is proven because the results obtained by the child have reached the target. At the 4th meeting, all children were said to be successful in using the demonstration model combined with the make a matching model assisted by audio-visual media.

The implementation of learning on the results of observations of children's activities matches the facts in the field that get an additional percentage until they get the most active criteria. Increasing children's activeness is there when following learning, children's attention in paying attention to teacher's explanations, analyzing images, children's courage in doing learning & motivation in comparing images.

3. Results of Children's Cognitive Development Ability

The results of the evaluation of the learning process carried out in Cycle I & Cycle II can be witnessed with the results of developing cognitive aspects of children in meeting 1 getting around 37.5%, at meeting 2 around 56%, atmeeting 3 around 81%. followed by meeting 4 around 94%. That result means it has reached the expected indicators.

Based on observations at meetings 1, 2, 3 & 4, it can be seen that teacher activities, children's activities & children's learning outcomes have increased. That has reached a predetermined indicator of success.

Thus, this class action research is successful & the hypothesis acknowledges that if cognitive aspects in comparing numbers with symbol numbers pass the demonstration model combined with a matching model assisted by audio-visual media in group B, RA Banjarmasin Islamic Image, the results of cognitive development will increase.

## III CONLUSION AND RECOMENDATION

Based on the results of classroom action research (PTK) conducted on child group B TK RA Banjarmasin Islamic image in comparing numbers with symbol numbers through a demonstration model combined with a make match model assisted by audio-visual media conducted in the 2018-2019 school year in the second semester developed most significant. The results of class action research in Cycle I & Cycle II can be decided as follows:

1. Teacher's activity in developing cognitive aspects in comparing numbers with symbol numbers combined with model make a match assisted by group B audio-visual media RA TK Islamic Image Banjarmasin has been carried out in accordance with the steps that have been decided with the best criteria.
2. Children's activities in learning to develop cognitive aspects in comparing numbers with number symbols through demonstration models combined with a make-match model assisted by RA Citra Islami Banjarmasin group B audio-visual media Banjarmasin felt an increase n each cycle with the most active criteria.
3. The results of the development of the cognitive aspects of the child in comparing numbers with the number symbol through the demonstration model combined with the make-match model assisted by group B audio-visual media RA TK Islamic Image Banjarmasin felt an increase with the best developing criteria.

The use of the demonstration model combined with the make a matching model assisted by audio-visual media can develop cognitive aspects in matching numbers with the symbol of group B numbers RA TK Islamic Image Banjarmasin is set to succeed.

Based on the results of the research & skills that have been described, the researcher presents a number of suggestions that need to be considered, including:

1. For Teachers

   The results of this research can be used as a solution to developing cognitive learning, especially in comparing numbers with symbol numbers to the extent that in the process of practicing the learning process training varies more according to the needs of the child. In addition to this, the teacher can correct performance in training to increase his professionalism as a teacher.

2. For Principals (TK)

The results of this research are desired to be able to help the school principal (TK) as an input material to increase the quality of learning in improving the process & learning outcomes of children in school (TK) in order to increase the quality of education as much as possible.

3. For Other Researchers

The results of this research are desirable as a guideline in learning work using a demonstration model combined with a make a matching model assisted by audio-visual media in an effort to correct the quality of learning in cognitive aspects & provide input for subsequent researchers in order to increase creativity in developing the research process.

**REFERENCE**


Gunawan, & imam. (2013). *Metode Penelitian Kualitatif.* Jakarta: PT. Bumi Aksara.

Kunandar. (2012). *Penelitian Tindakan Kelas.* Jakarta: Raja Grafindo Persada.

Mulyasa. (2015). *Revolusi Mental Dalam Pendidikan.* Bandung : PT Remaja Rosdakarya.

Purwanti, R., Suriansyah, A., Aslamiah., & Dalle, J. (2018). Introducing Language Aspect (English) to Early Childhood Through The Combination Of Picture And Picture Model, Talking Stick Model, Flashcard Media, and Movement and Song Method in b1 Group at Matahariku Bilingual Kindergarten Landasan Ulin Tengah Banjar. *European Journal of Education Studies, 5* (7), 1-7. doi: 10.5281/zenodo.1494188.

Safitri, M. E., Ibnu Ahmad, K., & Saleh, M. (2018). Development of Child Independence Through. *European Journal of Education Studies, 5* (7): 1-9.

Santrock & John, W. (2007). *Perkembangan Anak.* Jakarta: Erlangga.

Suriansyah, A. (2015). Pengembangan Pembelajaran Berbasis Tik (proses dan permasalahannya). *Jurnal Paradigma, 10*(2), 1-8.

Suriansyah, A., & Aslamiah. (2015). Strategi kepemimpinan Kepala Sekolah, Guru, Orang tua, dan Masyarakat Dalam Membentuk Karakter Siswa . *Cakrawala Pendidikan, 2013* (2), 34-38.doi: 10.21831/cp.v2i2.4828..

# 6. "Guru Sekumpul" as The Prophetical Model of Entreneurship from Islamic Perspective

Ersis Warmansyah Abbas, Sutarto Hadi, Ismi Rajiani
Lambung Mangkurat University Banjarmasin, Indonesia.

**ABSTRACT**

Though culture is closely related to religion, the role of religion has been mainly ignored in the study of entrepreneurship. In spite of Indonesia is the most populous Muslim country, so rare ulema is modeled as a successful figure in applying entrepreneurship from an Islamic perspective. *Guru Sekumpul* is an exception as he was successful for the concept in dakwah as well as develops economic base benefitted the community. Delivering a very interesting summon, practicing what is preached and archiving the thought by written works become the keys to create a path for economic growth and development of society for entrepreneurship based religion. Applying a qualitative method to gather data for it generates in-depth information , semi-structured interviews with five (5) key informants were conducted. Comprehending that EIP is worship leading to the concept of *Guru Sekumpul* that believes preaching does not mean begging including sending a budget proposal to other third parties. Thus, *Guru Sekumpul* finances dakwah with his own money and also distributes money for various social purposes and needs of the poor. At the same time, Guru Sekumpul teamed up trade with worshipers in running a business, entrusted capital, provided capital and motivate the devotees to strive. The understanding of Islamic economics as an arena of worship becomes the starting point of economic development. Thus, the model of dakwah of *Guru Sekumpul* should be disseminated within the framework of Entrepreneurship from Islamic Perspective (EIP).

Keywords: Ulema, entrepreneurship, dakwah, economic growth.

## I. INTRODUCTION

The interest in exploring entrepreneurship from cross-national views keeps on growing due to the significance of entrepreneurship to a nation's economic growth and development (Pinillos & Reyes 2011). However, cross-national studies to understand why the level of entrepreneurship is different among countries has either emphasized on institutional forces (e.g., Baker et al., 2005) or cultural aspects (e.g., Liñán & Fernandez-Serrano, 2014) where the cultural approach has led such research. However, though culture is closely related to religion, the role of religion has been mainly ignored in the study of entrepreneurship. The idea that religion—the sets of beliefs, activities, and institutions based on faith in supernatural forces (Stark & Bainbridge, 1985)—is linked to entrepreneurship is not recent. Weber's (1930) outstanding work set up the pillar to analyze the mechanisms of how religion can exist in society and affect societal members. While the thesis remains popular, more recent studies pose the question of how religion significantly affects the establishment of new businesses remains debatable (Elo & Volovelsky, 2017; Parboteeah et al., 2015; Audretsch et al., 2013; Choi, 2010; Dana, 2009).

Although as Galbraith and Galbraith (2007) mention, all religious traditions have addressed the connection between work (including entrepreneurship) and religion, Ojo (2019) notes that different religions value entrepreneurship differently. For instance, Islam's prohibition of interest payments also represents a barrier to capital and therefore constrains entrepreneurship. Further, research on Entrepreneurship from Islamic Perspective (EIP) is thin, peripheral, and negatively connotated (Gumusay, 2015). Ul-Haq and Westwood (2012) assert: "Islamic management and organization knowledge is relatively under- and misrepresented in the discussion." Research on Islamic management and EIP is hardly found from mainstream management journals. Scholarly work emphasizes primarily on Islamic Business Ethics or Islamic work ethics (Possumah et al. 2013). Tracey (2012) notes: "At the core on religion and business ethics research is the inquiry whether or not people who hold religious beliefs are more or less likely to behave ethically than people who do not hold such beliefs. As one might expect, there is evidence to support both positions." There exists significant amount of research on religious organizations in social psychology and sociology (Ysseldyk et al. 2010). However, the role of religious identity in and between secular business organizations is still under-researched. Religion is an integral part for many entrepreneurs as well as their organization and its ecosystem.

Though some scholars have recently engaged with the intersection of Islam and entrepreneurship (Ramadani et al. 2017; Harrison & Roomi, 2018), yet the metaphysical in the social sciences become for the researcher at least a social fact, when the actors believe in and behave accordingly It is necessary to integrate religion into the research agenda, and particularly EIP needs further attention, as many Muslim entrepreneurs actively seek to incorporate their religious beliefs with their business activities and both empirical merit analysis and scholarly engagement. The most prominent one is Muhamad Yunus, founder of the Grameen Bank Bangladesh who awarded the Nobel Peace Prize for pioneering the establishment of microfinance to boost economic and social development. In Indonesia, particularly in South Kalimantan, K.H. Muhammad Zaini Abdul Ghani known as *Guru Sekumpul* - literally translated as the master from Sekumpul- is another figure religión and business. With his concept, Sekumpul area which was once an abandoned wasteland now turns into a sacred satellites town of Sekumpul with tremendous economic development combining symbols of religion and the excitement the economic growth.

The previous study on the five main attributes: fathonah (intelligent and competent), amanah (trustable), siddiq (truthful and has a high integrity), tabligh (to convey religious thought communicatively), and istiqomah (consistency of courage), was indicated as the dimension of entrepreneurial characteristics from an Islamic perspective on Muslim entrepreneurs in Indonesia (Anggadwita, et al, 2017). However, in Indonesia alike the case of political green marketing (Rajiani & Kot, 2018), Islamic entrepreneurship obviously is easier to use in marketing and appears to be a marketing-based construct rather than an academically rigorous and theologically evidence-based one. As such this article aims at describing how the aforementioned dimensions are incorporated into the economic capability of the preacher (Guru Sekumpul) mainly in the attribute of tabligh translated into the thought of dakwah bil-lisan (delivering a very interesting summon), dakwah bil-hal (practicing what is preached) , and dakwah bit-tadwin (archiving the idea into written works) to create path for economic growth and development of society favoring and practicing entrepreneurship from Islamic perspectives.

## II. METHODOLOGY

This paper applies a qualitative method to gather data for it generates in-depth information of the realm and read between the lines people's under-

standing and involvement where people are being examined (Ormston et al., 2014). Semi-structured interviews with five (5) key informants were conducted. Data collected through observation, interview, and documentation. Data are analyzed using the model of Miles and Hubermand (2014): data reduction, data display, and conclusion drawing/verification. Data trustworthiness determining (Brod et al., 2009) is conducted by using the test of the levels of credibility, transferability, dependability, and conformability. Respondents were the regular attendants of religious lecture performed by the consisting of a student of the Islamic boarding school, a small size business owner, a medium size business owner, and a conglomerate. The combination is aimed at capturing a thorough understanding of the value delivered by Guru Sekumpul among societies. This way the writers applied a purposive sampling technique - a non-probability sampling that is primarily used when one needs to study for sure what needs to be examined and determine who are willing to support the information under knowledge or experience ( Oliver & Jupp 2006).

## III. RESULTS

Guru Sekumpul presents Islamic thought of commanding the good and forbidding the evil in such an impressive way. Supported with in-depth knowledge about Islam, broad general knowledge, tacit cultural understanding, polite and warm as well as equipped with personal mastery of the commonly spoken language in the region, Guru Sekumpul attracts audiences to the deliver Islamic thought based on the Koran, the Hadith of the Prophet, and the Islamic Shari'a to strengthen faith, increase devotion, and emulate the Prophet Muhammad through three da'wah concepts: da'wah bil-lisan, da'wah bil-hal, and da'wah bit-tadwin.

Those three concepts are later on known as Guru Sekumpul ways in developing economic models by opening new areas then developing a business model so that Guru Sekumpul possesses the capital to carry out da'wah and motivate the people to work harder to make Sekumpul Region become the center of the community's economy.

The holy Koran recital led by Guru Sekumpul (K.H. Muhammad Zaini Abdul Ghani) is an education-based da'wah. Guru Sekumpul guides on how to improve people themselves, their families, the immediate environment, and community-based moral education to build good conduct. Learning through wis-

dom, Guru Sekumpul aims the recital participants to strengthen faith in God Almighty, increases devotion to God, and imitates the Prophet, Muhammad. For this purpose, Guru Sekumpul develops da'wah bil hal that combines the study and the deeds to model Guru Sekumpul's conduct which is based on an understanding of the life of the Prophet Muhammad as an example. Prophet Muhammad had been charged in the economic development during his childhood when he became a shepherd and performed business activities to ensure that economic growth was essential for life. As assessed by Max Webber (1930) that religion and piety encourage the development of the economy (capitalism); The Protestant Ethic and the Spirit of Capitalism, especially in view of the Calvinists. What was assessed by Webber this day was done by Prophet Muhammad (PBUH) 20 centuries ago. In line with Calvinists, Guru Sekumpul interpreted doing business (economic development) as a personal duty of Muslims and disseminated it to the people as the obligation of preachers. The spirit of economic growth is interpreted as charity. The phrase is well known among Muslims: "Work for your world as if you live forever and for yours year after as if you will die tomorrow.

This is in line Hadith Prophet Muhammad (PBUH): If you are in the morning, do not wait for dusk. If you are in the evening, do not wait until morning. Take advantage of your common time before coming to your sickness. Make the time of your life before coming to your death (Riwaayat AL-Hadiith, Bukhari).

The spirit of religion and preaching by practicing what it preached, in the terminology of Banjarese people, the native of South Kalimantan Indonesia is known as kaji (to examine) and gawi (to do). Kaji means to investigate, both theoretically and empirically, in this case, the economic development to get the belief that economic growth is essential and should be done. Gawi means practicing what is examined. Guru Sekumpul believes it is as a religious obligation and an arena for conducting good deeds because that he develops a variety of businesses, teams up with the pilgrims, helps the pilgrims or motivates them.

This is consistent with the seminal work of Gertz (1963) in Indonesia that reveals the central role of the Muslim middle class in the field of entrepreneurship where trigger of economic development are pious Muslims based on the understanding that developing the economy as a religious duty. In the context of Muslims in Indonesia, according to Hasan (2014) reformists of Islam support capitalism in the Indonesian environment where the reformists of Is-

lam are considered as a substantial economic development.

With the approach of kaji (to examine) and gawi (to do), Guru Sekumpul can accumulate capital to finance the missionary activity, to develop capital, to invest, and to help those in need. Socially, Guru Sekumpul purposely delivers free lectures and assists devotees during the event with the aim of righteous deeds, not for image portraying. By having adequate financial capital, Guru Sekumpul does not rely on help from the various parties for preaching activities. Considering that the place is not sufficient to seat devotees and to develop the economy of the community, Guru Sekumpul migrates to a remote area known as Sekumpul which is, later on, growing so fast economically then making K.H. Muhammad Zaini Abdul Ghani is more recognized as Guru Sekumpul. Region Sekumpul initially is without occupants. The devotees of Guru Sekumpul buy land and build houses in this area with the intention to be closer to the master. Purchasing of land and housing establishment stretch the economy and in line with the rapid growth of teaching and Holy Koran recitation make Sekumpul Region turn into areas where transactions of various purposes of economic activity occur. Societies open the shop and build shops so that economics community model of 'Islamic market' is developed. Islamic economic developments in the region are based on the fatwa Guru Sekumpul that life will be safe and sound, peaceful and prosperous outwardly and inwardly if it is based on Islamic values.

Guru Sekumpul exemplifies private economic development by trading natural stone rings, both belong to him or the trust of others, join venturing or entrusting capital. The rapid expansion of the Sekumpul Region makes Guru Sekumpul, students and devotees can set up shop, property, car showrooms, printing, fast food, bakery, perfume and other approximately 108 products.

Da'wah bil-hal of Guru Sekumpul is so memorable for students and recitation devotees. Khairullah, a young boy from Barabai (125 km from Martapura) who studied at an Islamic boarding school, was aspired to be a preacher. Because parents are not from a wealthy family, Khairullah worked as a construction worker to meet the needs of the school and follow the teachings of Guru Sekumpul to establish religious knowledge.

In one study, Guru Sekumpul said:

> *A preacher should be supported by financial ability in order not to stretch out your hand."*

Guru Sekumpul speech made an impression on his mind and be a mo-

tivation for working harder. Now, after 30 years old, Khairullah runs the business of housing, and the company keeps growing. Khairullah is so determined in establishing financial gains that preaching activity is no longer problems. The admiration to Guru Sekumpul is channeled by establishing a community in the social network Facebook while building the friendship of his fellow pupils or lovers of Guru Sekumpul.

Being honest and expanding the relationship as the key to a successful endeavor are the teachings of Guru Sekumpul practiced by Hamdi Djunaid, a businessman of housing, shops, car rental, a brick press, and various other business branches. Hamdi Djunaid is not alone as there are thousands of students and lovers of Guru Sekumpul who gain useful lessons from da'wah bil-lisan dan da'wah bil-hal. Haji Sulaiman Basirun the South Kalimantan conglomerate that develops business in the field of mining, shipping, road traffic coal, print media, and a variety of other companies are very impressed with the teachings of Guru Sekumpul about entrepreneurship grounded in Islam. He said:

> "*As a businessman, I certainly have ever experienced hard times. I am once nearly bankrupt. Guru Sekumpul gives spiritual cleansing that temptation comes from Allah the Almighty. Behind the trials, when we are able through with sincerity, Allah will bring sustenance without we thought.*"

As a devotee, Rusdi Maulana always follows the teachings of Guru Sekumpul. For small trader like Rusdi, Guru Sekumpul uplifts the economy. The number of devotees coming to Sekumpul is beneficial for him because many of them bought picture frames he sells to display the picture of Guru Sekumpul. Preaching and doing business as an "arena of worship make financial capability of Guru Sekumpul more than enough. For those who take the Sufi path, Guru Sekumpul chooses a simple life, not extravagance. Treasures of Guru Sekumpul are given as money for various social purposes. In a simple example, devotees coming to Sekumpul Holy Koran recital are supplied drinking water, bread, and books and even few individuals or institutions that need Guru Sekumpul assists the funds.

Muhammad Husni, an entrepreneur who develops business, started from showroom car, motorcycle dealer, Hajj travel, and various other companies, ensures Guru Sekumpul as people who live ascetic lives. Guru Sekumpul earns money from selling rings and jewels, but the results of such efforts are just given to the needy. It is not intended to accumulate wealth, but to support

missionary activity and to prepare for the cost of education of children and families Guru Sekumpul. With adequate financial support, of course, action will be echoed far away.

Guru Sekumpul views property as a surrogate of Allah and the rights of others who need it is on our property as for Guru Sekumpul, assets acquired through business is not 'property. In a religious gathering firmly he said:

> *"I am not the owner of the treasure. The treasure belongs to Allah and is used for the sake of da'wah."*

During the development of Ar-Raudhah complex to complete various facilities, many third parties who will intend to donate the construction of the complex are subtly rejected as it is against the principle of Guru Sekumpul to become ulema asking instead of giving. Ulema is an example to followers in every way of life. Regarding doing business, the Messenger has set up a model and doing business is the realm of worship. A Muslim is not forbidden to become rich as with the wealth; it is possible to give charity and assist activities of the people in the principle that treasure from God should be entrusted to someone to be utilized for the benefit of humankind.

Referring to Prophet Muhammad as a model, Guru Sekumpul not just preaches the importance of running the business, but he practices it that becomes a role model for students and devotees resulting in many successful people in the industry ranging from small to the conglomerate level.

Remarkably, this business is run under Islamic values corridors and not in the spirit of capitalism where accumulating wealth is not the most important thing, but how useful the treasure for the progress of Islam is.

## IV. CONCLUSION

EIP is more than merely a simple summary of Islam and entrepreneurship as it is based on three interwoven pillars; the pursuit of opportunities, socioeconomic or ethics guided by a set of norms, values and recommendations and religio-spiritual that links people to God with the ultimate objective of pleasing Allah. Since , these pillars have specific scriptural sources as well as institutions and processes of interpretation, EIP then contains its own methodology of approaching its understanding to be comprehended and analyzed holistically containing entrepreneurial pursuit, religiously-shaped values, concrete Islamic obligations, community-influence, scriptural sources and an ecosystem

of actors, and institutions which provide an interpretation for this religio-spiritual lens. Comprehending that EIP is worship leading to the concept of Guru Sekumpul that believes preaching does not mean begging including sending a budget proposal to other third parties. Thus, Guru Sekumpul finances da'wah with his own money and also distributes money for various social purposes and needs of the poor. At the same time, Guru Sekumpul teamed up trade with worshipers in running a business, entrusted capital, provided capital and motivate the devotees to strive. The understanding of Islamic economics as an arena of worship becomes the starting point of economic development. Thus, the model of da'wah of Guru Sekumpul should be disseminated within the framework of Entrepreneurship from Islamic Perspective (EIP).

## REFERENCE LIST


Anggadwita, G., Ramadani, V., Alamanda, D. T., Ratten, V., & Hashani, M., 2017. Entrepreneurial intentions from an Islamic perspective: a study of Muslim entrepreneurs in Indonesia. *International Journal of Entrepreneurship and Small Business, 31*(2), pp. 165-179.

Audretsch, D. B., Boente, W., & Tamvada, J. P., 2013. Religion, social class, and entrepreneurial choice. *Journal of Business Venturing, 28*(6), pp.774-789.

Baker, T., Gedajlovic, E., & Lubatkin, M. ,2005. A framework for comparing entrepreneurship processes across nations. *Journal of International Business Studies, 36*(5), pp. 492-504.

Brod, M., Tesler, L. E., & Christensen, T. L. ,2009. Qualitative research and content validity: developing best practices based on science and experience. *Quality of Life Research, 18*(9), pp.1263.

Choi, H. ,2010. Religious institutions and ethnic entrepreneurship: The Korean ethnic church as a small business incubator. *Economic Development Quarterly, 24*(4), pp. 372-383.

Dana, L.P., 2009. Religion as an explanatory variable for entrepreneurship. *The international journal of entrepreneurship and innovation, 10*(2), pp.87-99.

Elo, M., & Volovelsky, E. K. ,2017. Jewish diaspora entrepreneurs-the impact of religion on opportunity exploration and exploitation. *International Journal of Entrepreneurship and Small Business, 31*(2), pp. 244-269.

Galbraith, C. S., & Galbraith, D. M. , 2007. An empirical note on entrepreneurial activity, intrinsic religiosity and economic growth. *Journal of Enterprising Communities: People and Places in the Global Economy, 1*(2), pp. 188-201.

Gümüsay, A. A. ,2015. Entrepreneurship from an Islamic perspective. *Journal of Business Ethics, 130*(1), pp. 199-208.

Harrison, P. and Roomi, M.A., 2018. 5. Islamic insights on entrepreneurial leadership. *Research Handbook on Entrepreneurship and Leadership*, p.106.

Hasan, N., 2014. Between the global and the local: Negotiating Islam and democracy in provincial Indonesia. *In Search of Middle Indonesia*, p.171.

Liñán, F., & Fernandez-Serrano, J. ,2014. National culture, entrepreneurship and economic development: different patterns across the European Union. *Small Business Economics, 42(*4), pp. 685-701.

Miles, M.B., Huberman, A.M. and Saldana, J., 2014. *Qualitative data analysis*. Sage.

Ojo, S., 2019. The Confluence of Religion and Ethnic Entrepreneurship in the Informal Economy. In *Informal Ethnic Entrepreneurship* (pp. 45-62). Springer, Cham.

Jupp, V., 2006. *The Sage dictionary of social research methods*. Sage.

Ormston, R., Spencer, L., Barnard, M., & Snape, D., 2014. The foundations of qualitative research.

*Qualitative research practice: A guide for social science students and researchers, 2*, pp.52-55.

Pinillos, M. J., & Reyes, L. ,2011. Relationship between individualist–collectivist culture and entrepreneurial activity: evidence from Global Entrepreneurship Monitor data. *Small Business Economics, 37(1)*, pp. 23-37.

# 7. The Bilingual School Program Management

Eko Prayitno, Sutarto Hadi, Muhammad Saleh
University of Lambung Mangkurat, Banjarmasin, South Kalimantan.

**ABSTRACT**

At the moment, the number of bilingual middle schools is highly limited, however, there is one public and one private middle school in Banjarmasin. The purpose of this study therefore, is to understand the planning, implementation and evaluation of bilingual school programs and their subsequent assessment and constraint, using qualitative descriptive method, with a case study approach. Furthermore, the analysis derived the following conclusions: Schools that run a bilingual education plan, do so according to their personal goals and objectives, private institutions possess the freedom to implement the program, evaluation of multi-lingual educational organizations occur with the same frequency, objectives and goals as conducted in other schools. The challenge, or limitation, observed in these institutions is that not all students are comfortable in a bilingual learning environment. This report further recommends that relevant educational agencies should provide opportunities for teachers to participate in international linguistic forums and principals should also develop a language certification program for staff. There is a need for teachers to consistently develop their English-language skills and that researchers should continue to focus their analysis on one aspect of bilingual school management.

Keywords: management, program, school, bilingual, bilingualism

## I. INTRODUCTION

The process of fostering strong international relationships requires young Indonesians to master foreign languages, English especially. However, this is important because it is the most commonly used international language and it is one of the six official international dialects, listed by the United Nations (UN),

others include, Spanish, French, Arabic, Chinese and Russian. Furthermore, this makes English a compulsory subject for secondary education, hence onethat is tested in National Examination subjects.

The Indonesian Government's policies, requires that English in secondary schools and local communities are more aware of its importance in many societal functions. Furthermore, evidence has shown that bilingual course institutions are expanding into various regions and cities across Indonesia and students and members of the local, general community, academics and other professionals enroll for this program.

As the name suggests, bilingual schools utilizes two languages in constructing classroom and surrounding conversations and teachers use both Indonesian and English in their delivery. These special schools provide the skills needed in today's society by delivering fluent learning outcomes in middle school, which requires that all subject teachers have satisfactory English-language competence.

Education management also includes all that is related to the administration of the dialect learning process, hence, the objective is to achieve the short, medium and long-term goals of improving edifying outcomes (Mulyasa E., 2009).

Supervising a school makes provision for an effective workplace experience for administering other educational entities. Furthermore, the administration of educational institutions possess similar pursuits, which can be considered from three points of view, which includes as, a science, an art and an activity process (Suprihatin, 2004).

Similarly Chin & Wiggleworth (2007) separated bilingualism skills into 2 (two) categories (types), including, balanced bilingual, involving the satisfactory eloquence of someone in a different context, here, the achievement has not been obtained because Indonesia still takes English as a foreign language and not an official language for public instruction. Furthermore, the second is dominant bilingual, where someone is more likely to use one language only in bilingualism. Hopefully, the second type can be applied in the education system in Indonesia today.

Schools should carefully and measurably prepare a program and some terms often used when creating a bilingual school, include staffing, teacher recruitment, teacher certification or staff development and curriculum advancement (Pranowo, 2005)

In bilingual lessons, it is normal to have teacher collaboration in a class because the use of multilingual schoolroom learning models and the partnership in a study, suggesting that this collaboration is very beneficial to both instructors (Lee, 2008). Furthermore, English teachers should possess an awareness of potential linguistic problems that could arise from other tutors in certain subjects and other positive factors on why the activity should be adapted should also be considered.

The purpose of this study is to get an overview of Planning, Implementing, evaluating of the bilingual program. Beside, following up, and obstacles of the bilingual program at The State Middle School of Paringin 4 and The Middle School Al Mazaya of Banjarmasin.

## II. METHODOLOGY

In accordance with the research theme, the approach used was descriptive qualitative analysis, which is relevant in the evaluation of problems that requires the conducton of a critical study, to enhance understanding and clarification, through an intensive relationship with the data source.

However, from the type, this research is also attributed to conduct the strategy of a case study. Furthermore, the data obtained were based on planning, implementation and evaluation of schools with bilingual programs and also, a follow-up with constraints of programs were further sought.

The research data to be sought include staff recruitment, teacher sertification, curriculum development and staff development. Especially for curriculum development, the data tobe developed include lesson plan, school facility, English community, and classroom activities.

The sources of information obtained in the investigation included the Principal, Vice of Principal for Curriculum Fields and the Teachers, with techniques, including interview, documentation and observation. The analysis method involved cross-site data, with the purpose of comparing information and also integrating findings obtained from each site studied.

Furthermore, the data acquired from The State Middle Schools of Paringin 4 and Al Mazaya of Banjarmasin, were tested in stages for their validity, using Triangulation.

To guarantee the legitimacy of the information obtained, the following techniques were applied: Firstly, Credibility Test, here, the criterion aims to

prove that the data collected in the field, really contains truth values, by applying the extension of observation, increasing perseverance and triangulation. Secondly, Dependability Test, which involves an audit of the entire research process. Furthermore, after field observations, analysis was conducted on the data, which drew a conclusion that the research was actually carried out. Thirdly, Conformability Test, carried out simultaneously with dependability, involves the examination of the results of research. This was further expected to increase the quality of the investigation conducted.

## III. FINDINGS AND DISCUSSION

The State Middle School of Paringin 4 is the only public bilingual school in South Kalimantan. The school has a National Examination achievement that is prominent in English subjects. Whereas The Middle School Al Mazaya of Banjarmasin is a private junior high school that also has good achievements in terms of English especially at the junior high school level in Banjarmasin. The students often win various English language skills competitions.

This study identifies several aspects of management, which includes planning, implementation and evaluation and further reviewed the follow-up and obstacles in the bilingual school program.

From the planning aspect, the Short Term strategy at The State Middle School of Paringin 4, include, the research site, recruitment of educators and education staff, learning materials and the school curricula. However, the Medium Term Plans include certification of English language skills and professional development for teachers and other education staff. Furthermore, the Long-term Plan was curriculum development.

Conversely, at the second research site, The Middle School Al Mazaya of Banjarmasin, same reports were observed for short, medium and long term plans as with the first research site.

At The State Middle School of Paringin 4, the following were observed: Recruitment, involved that teachers and administrative staff in the school were from the selection of Civil Servants and Contractors, which is in line with the authority of the Balangan Regency Government and the Education and Culture Office.

Conversely, regarding learning materials, the Education Unit Level

Curriculum (KTSP), using the 2013 curriculum (K13) and 2006 was developed. The old curriculum (2006), was however still used in class IX (nine), while K13 was applied in class VIII (eight) and VII (seven). Furthermore, extra learning in English subjects, commonly called Local Content was given 2 (two) hours per week, using specific guidelines available at The State Middle School of Paringin 4, not involving material source from National Publishers in general. The information provided is mostly from A Basic Course English Nine Hundred, which aims to improve the ability of students, especially in speaking skills.

Furthermore, Learning Implementation Plan, involves each teacher to gradually make an education Implementation Plan (RPP), to be approved by the Principal. However, the first research site has a strategy format, not much different from other schools, just some differences in presentation and that it is obtainable in 2 (two) languages, Indonesian and English.

English proficiency certification illustrated that Schools in this study did not have a specific policy regarding teacher certification in their English abilities. Professional Development at Paringin 4 Public High School was regular and continuous. However, this was not always sustained in schools because the activity was also facilitated by relevant agencies, e.g. the Education and Culture Office of Balangan District.

Curriculum Development involved that schools possess communities and facilities that support good bilingual learning, with the focus of utilizing both languages in a balanced manner and promoting collaboration between teachers in bilingual classes.

Conversely, at the Middle School Al Mazaya of Banjarmasin, the following were observed: Recruitment of Educators and Education Personnel criteria used do not exist in other schools as they presented some special requirements for prospective new teachers. Furthermore, the forthcoming tutors must have mastered the teaching skills in their fields, be capable of meticulously reading the holly Qur'an and also take advantage of Information Technology.

Curriculum and Learning Materials used were contained in the document 1 (one) of the KTSP of Al Mazaya Middle School Banjarmasin, structured to provide guidance on how to implement bilingual schools, thus improving their value. Furthermore, the prospectus includes details on how to recruit employees that must master Information Technology, possess multi-

media expertise in teaching and have a sound Holy Qur'an memorization skill.

English Language Certification were not required at this school because the skills were required by physical proof, through interviews held in the school, where the proper test for prospective staff was conducted.

Professional Development was absolutely given to teachers, in order to improve their scientific capacity in executing their duties, which was routinely held at the premise.

Curriculum Development approach taken by this institute include encouraging facilities and a bilingual community and school culture, classroom learning, with emphasis on using dialect in the classroom, teacher collaboration and students' understanding of the concept.

The follow-up aspects of the program, both research sites have a high school that is also based on multilingualism in their learning.

The program constraint observed in Paringin SMP 4 was that some students who have not been able to follow the classes properly, which was also discerned in Al Mazaya Middle School, hence, they must be given special treatment and lessons.

In a curriculum that is nuanced with religion, it is known that many private schools, including Al Mazaya, have a wide space in developing characters that are very positive and the Principal was very instrumental. Furthermore, this research is consistent with that carried out by Suriansyah & Aslamiyah (2015), at SDIT Ukhuwah Islamiyah Banjarmasin, which stated that the Principal has a religius philosophy in developing schools, hence they can be developed in a modern way, without leaving the aspect of religion.

In the aspects of implementation in both middle schools, there were processes such as the recruitment of educators and administration staff, learning materials, school curriculum, knowledge of plan implementation, certification of English language skills, professional and curriculum development. Furthermore, syllabus improvement involved community and facilities in bilingual learning, classroom education, multilingual school culture, with emphasis on language use, teacher collaboration and learning methods, the use of bilingualism in the schoolroom and assessment of students understanding in dialect education as a custom. Furthermore, these

findings are in line with the research carried out by Suriansyah, (2014), where it was stated that schools must advance their culture to obtain good performance from its residents. The religious culture is also important in advancing the quality of education in bilingual schools which was supported by the research carried out by Karsa (2018), which stated that emotional intelligence from teachers also strongly supports the progress of the institution.

Schools develop curriculum, especially by increasing the number of English lesson hours and also by learning, based on the use of Information and Computer Technology (ICT), which makes teachers increasingly motivated to educate (Permadi 2019). Furthermore, this practice is good for providing more learning experiences in terms of language however these schools offer good facilities for its implementation as Suhaimi & Rinawati (2018) in a research stated that schools have a great authority in developing education.

Program evaluation is carried out continuously by the institutions. The State Middle School of Paringin 4 conducts program evaluations twice a year, while The Middle School Al Mazaya of Banjarmasin practices this, once a week. However, this is a good step to control the bilingual program hence its development can always be monitored. Furthermore, principals also take strategic steps to advance schools through evaluation, in line with the discovery by Suhaimi & Khalik (2018), which state that the breakthroughs impacted by the Principal, really determines the progress of the institution. The results further supports the pre-existing research from Suhaimi & Efendi (2018), which states the important role of a Principal, in relation to the performance of teachers in the learning environment, relating to the methods they apply, while running all the school programs.

The alumni of The State Middle of Paringin 4 were given the freedom to further their education at any high school of interest, however, the Regional Government of Balangan District, provided a place (establishment of a State High School), where Bilingualism was implored in learning, further known as The State High School of Paringin 2, District of Balangan.

The second research site, by its Foundation, was given a place to channel their interests and talents (The High School Al Mazaya of Banjarmasin) and also a bilingualism learning program. Furthermore, the alumni who continued to other schools were also given the widest opportu-

nity as some of them furthered their education in high schools within the vicinity. Providing students with opportunities is the right direction to venture into, for those who manage an educational institution because it is a moral responsibility step imprinted in the generation, planned by a particular educational institution. Furthermore, this program is supported by the conducive environment provided by the school, which include, high school with a common base (bilingualism). In a research conducted by Salasiah (2018), it was proven that an encouraging environment also improves a students' character.

The running program cannot be separated from challenges and obstacles hence the State Middle School of Paringin 4 faces several disputes, which include the presence of students who are shy to say English sentences. Conversely, at The Middle School Al Mazaya in Banjarmasin, a small number of students were not fluent in the language, therefore, the school provided treatments in the form of programs, outside the environment. Furthermore, they sent these students to Kampung Inggris (which means English Village), in East Java Province which was a very positive step to improve students' abilities, especially in Speaking Skill. However, the role of schools and school-based management is very important to address the challenges of the program and the two bilingual schools above have good administration hence they can follow up on existing constraints, which is in line with the discovery of Alamsyah (2019), that these Management systems improve school progress.

The private schools are more flexible in fund raising, including finance for developing students' abilities in English, hence, the Middle School Al Mazaya, Banjarmasin, possessed an awareness of this capabilities at an inexpensive costs however, this has become a shared awareness. This Further corresponds with how parents participate in supporting children's education and how institutions maximize School-Based Management, in the educational unit environment and how the relationship with parents is very important as Artini & Nitiasih (2014) revealed that parental participation in student education is very important for education can be successful as moral and materials, supports and plays an important role in the implementation of quality education in schools, especially bilingual institutions. Furthermore, it cannot be released by the role of the Principal because they manage and control the school, as research conducted by Rachmadinoor (2018), reported that Principals as managers,

educators and motivators, greatly influence the quality of educational institutions.

Non government schools are more flexible in raising funds including funds for developing or enriching students' abilities in English. The Middle School Al Mazaya of Banjarmasin with an awareness of programming enrichment and development of students insights with inexpensive costs. However, this has become a shared awareness. This corresponds to how parents participate in supporting children's education and how schools maximize School-Based Management in the educational unit environment. How this relationship with parents is very important. Artini & Nitiasih (2014) revealed that parental participation in student education is very important so that education can be successful. Moral and material support plays an important role in implementing quality education in schools, especially bilingual schools. It cannot be released is the role of the Principal as the principal manager and controller of the school. As research conducted by Rachmadinoor (2018) found that Principals as managers, educators, motivators greatly influence the quality of educational institutions.

The study limitation of theresearch is that the research focuses on the management of bilingual schools according to the school documents. Besides that also finds to whatever school policies relating to management of bilingual programs.

## 1V. CONCLUSION AND RECOMENDATION

The conclusions of the research are:

Firstly, in the planning processes, at the State Middle School of Paringin 4 and Al Mazaya of Banjarmasin, which included Staffing, Teacher Recruitment, Certification, Development and Curriculum Development, the bilingual schools took steps that were aligned with the Vision, Mission and Objectives. Furthermore, the institutions ran a plan in accordance with the Leading function, hence also in agreement with the objectives of the educational institution.

Secondly, at the step of program implementation of bilingual schools, both schools had different implementations in the field, where they were adjusted to their individual cultures and structural rules. Fur-

thermore, it is known that The State Middle School of Paringin 4 (as a government institution), has limitations with this implementation because of the regulations that must be followed, while the other institution researched, which was managed by the Foundation, possessed the freedom to determine education policy in the unit environment. However, schools develop in science and technology as well as on their religious character which is typical for religious- based schools.

Thirdly, evaluation phase in a bilingual school indicated that both schools had the same goal, which include, control over all the plans made and also to maintain the quality of learning. Furthermore, the difference was actually in terms of frequency in conducting evaluations, where the private school evaluated more often than The State government School, within one year.

Fourtly, the follow-up on the institutions were conducted to establish a High School, based on bilingual. Furthermore, Balangan District Government established The State High School of Paringin 2 and the, alumni of The private Middle School, were also given the opportunity to be able to continue at The High School Al Mazaya of Banjarmasin, which is also based on bilingual.

Fifthly, the Program constraints observed from the implementation of a bilingual schoolare based on the uneven ability of students to master English. However, the background of different dialect skills and adaptability in a bilingual environment is often the reason for the diverse abilities of students because Schools provide enrichment, via additional programs that aim at students who have not been able catch up to speak English fluently.

The importance of professional development for bilingual teachers is very good if the Office and Culture provides an opportunity, which is further facilitated to take part in an international scientific forum for teachers in bilingual schools, in an attempt to improve language skills and learning in multilingual schools on an ongoing basis.

Proof of ability to speak a language for all staff was very important, as Structured planning by the Principal, in terms of certification for Educators and Education Personnel is very good on the long-term bilingual program.

Furthermore, the teachers are very important part of the bilingual program as they are expected to always hone themselves with good language skills, especially in English skills (oral and written), hence it was good for them to take an English language proficiency test, including TOEFL, TOEIC etc and also regularly take part in a scientific forum of language teaching .

It is however expected that further researches should focus on just one aspect of management hence they can appreciate specifically the ideal bilingual school, especially in South Kalimantan.

**ACKNOWLEDGMENT**

The researchers express their gratitude to the supervisors who provided a very useful path, as well as the schools that has provided the opportunity to conduct this investigation. Furthermore, the editorial works of the j-k6em journal and all parties who also helped in the publication of this scientific work were also appreciated hence may the good deeds that have been given to us be answered by Allah Almighty, with abundant replies.

**REFERENCE**

Alamsyah. (2019). School Based Management Implementation To Improve School Quality Of Multi Sites Study in SDN Alalak Selatan 2 and SDN Alalak Selatan 4 Banjarmasin City. *IJSDR*, 4(1), 138.

Chin, & Wiggleworth. (2007). *Bilingualism: an Advances Resources Book.* Abidgon: Routledge.

Karsa, Y. A. (2018). Contribution of Learning Management and Emotional Intelligence to Performance and Work Effectiveness of Teachers at Public Elementary School in Barambai Sub-District. *IOSR Journal of Research & Method in Education, 8*(6), 26.

Lee. (2008). Interdisciplinary Collaboration in English Language Teaching: Some Observation from Subject Teacher's Reflection. *Reflection on English Language Teaching*.

Mulyasa, E. (2009). *Manajemen Berbasis Sekolah: Konsep, Strategi, dan Implementasi.* Bandung: PT Remaja Rosdakarya.

Permadi, M. A. (2019). The Relationship Of Work Motivation And The Use Of Communication and Information Technology (TIK) With Quality

Service At Islamic School (MAN) In Banjarmasin, Indonesia. *European Journal of Alternative Education Studies*, 4(1), 72.

Pranowo. (2005). *Teori Belajar Bahasa: Untuk Pendidik Bahasa dan Mahasiswa Jurusan Bahasa*. Yogyakarta: Pustaka Pelajar.

Rachmadinoor. (2018). Role of School Heads in Improving Quality of Education. *IJSDR*, 3(12), 72.

Salasiah. (2018). Instilling Character Values In Early Childhood In The Perspective Of Curriculum And Parenting (Multi-Site Study in Paud Islam Sabilal Muhtadin And PAUD Mawaddah,

Banjarmasin, Indonesia). *European Journal of Education Studies*, 5(7), 46.

Suhaimi, & Efendi, N. (2018). Hubungan Peran Kepala Sekolah Dan Sikap Terhadap Profesi Guru Dengan Prestasi Kerja Guru SMA Negeri di Kabupaten Hulu Sungai Selatan. *Lentera Jurnal Ilmiah Kependidikan*, 13(1), 73-83.

Suhaimi, & Khalik, A. (2018). Kepemimpinan Transformasional Kepala Sekolah pada SMP Muhammadiyah 4 Banjarmasin. *Jurnal Penelitian Tindakan dan Pendidikan*, 4(1), 40. Suhaimi, & Rinawati, Y. (2018, December). *The Management of Character Education Curriculum at Vocational High School 2 Kandangan*. Paper presented at 1st International Conference on Creativity, Innovation, Technology in Education Retrieved from https://download.atlantis- press.com/article/ 55909600.pdf.

Suprihatin. (2004). *Manajemen Sekolah*. Semarang: UNNES PRESS.

Suriansyah, A. (2014). Hubungan Budaya Sekolah, Komunikasi, dan Komitmen Kerja. *Cakrawala Pendidikan*, 33(3), 365.

Suriansyah, A., & Aslamiyah. (2015). Strategi Kepemimpinan Kepala Sekolah, Guru, Orang Tua dan Masyarakat Dalam Membentuk Karakter Siswa. *Cakrawala Pendidikan, 34*(02), 238.

# 8. The Relationship of Work Motivation and The Use of Communication and Information Technology (TIK) with Service at Islamic School (MAN) in Banjarmasin, Indonesia

Muhammad Ali Permadi, Sutarto Hadi, Mahrita

Lambung Mangkurat University, Indonesia

**ABSTRACT**

The purpose of this research is: (1) to describe the relationship between work motivation and quality service of Islamic Senior High School in Banjarmasin; (2) to describe the relationship between the use of information and communication technology and quality service of Islamic Senior High School in Banjarmasin; (3) to describe the relationship between work motivation and the use of information and communication technology simultaneously with quality service of Islamic Senior High School in Banjarmasin. This research used quantitative approach and descriptive method. The population of this research is all Islamic Senior High School teachers in Banjarmasin. This research also used proportional random sampling to take sample. The amounts of the samples are 127 teachers. Data collecting technique that is used in this research is questioner and teacher performance technique. The research used statistic test, analysis of correlation and T-test as data anaylisis technique. The research showed that: (1) there is significant relationship between work motivation and Quality service Islamic of Senior High School in Banjarmasin, (2) there is significant relationship between the use of information and communication technology and quality service Islamic of Islamic Senior High School in Banjarmasin, (3) there is significant relationship between relationship between work motivation and the use of information and communication technology simultaneously with quality service of Islamic Senior High School in Banjarmasin. The recommendation for the teacher is to concern and improve the work motivation especially in teaching and learning process. Attending some workshop based on his job in order to function the use of information and communication technology at school. This can be strengthened by concerning some factors related to the improvement of quality service.

Keywords: motivation, information and communication technology, quality service

## 1. INTRODUCTION

The problem of quality and quantity of education is not independent, but dependent to influencial system. Output quality is influenced by input and the process of quality. The problem of education quality is a big work that needed the participation of many sectors and any resources. One of promising resources is communication and information technology means (TIK/ICT) (Haddad, 2005). TIK competency is capable of supporting the efforts of quality increasing and expanding the education link to another city.

In improvement of Education quality, the availability of teacher and educational staff is one of significant and strategically factor that influenced the education quality. The problem here is the lack of teacher's quantity, discrepancy of whom and teaches some lesson that belongs to teacher ability (mismatch) (Sidi, 2003). Work Motivation is needed in learning process. Motivation is basic instigation that moved someone to do something from the one self-based in their own. Therefore, what one do from their instigation consist of a theme based of what is based (Uno, 2007). Beside motivation, TIK also is expected to help the improvement of service and quality of education.

Based on Mulyadi (2004) quality is the product that always referred to consumer's satisfaction because they are the main keys that created the competitive organization and keep the continuity of organization in a long term. Therefore, teaching learning process must be designed as good as possible at school in order to give a good service for the students. One of the efforts to do is optimizing the use of communication and information technology in teaching and learning process in the classroom.

## II. METHODS

Based on research plan, this research is meant to describe whether there is significant relationship between work motivation and the use of TIK with Quality service in Islamic Senior High School (MAN) in Banjarmasin or not. The quantitative method is used in the research with correlational technique. This technique is used to describe whether there is a significant relationship between two variables or some. By using this technique, it can be described various relationship into one variable to another (Arikunto, 2010).

The relationship between one variable to another is describes by coefficient and significances. The research variable is consist of two independent variables that is, Work Motivation (X1) and The Use Of TIK (X2) and one dependent variable that is Learning Quality Service (Y). the relationship among variable are capable of being explained by this formulation of the problem: (1) The Relationship between work motivation (X1) and quality Service (Y) Islamic Senior High School in Banjarmasin, (2) The relationship of the use of TIK (X2) and the quality service (Y) Islamic Senior High School in Banjarmasin, (3) The relationship of of work motivation (X1) and the use of TIK continuously with quality service (Y) Islamic Senior High School (MAN) in Banjarmasin.

Population is the whole research object (Arikunto, 2003). Hadi (1999) explained that population is all the members of group that will be researched or the obvious limited object. Population is the object or subject that takes place in a region by fulfilling some requirements related to the research conducted ahead. Population in this research is all the teachers of Islamic Senior High School (MAN) in Banjarmasin. The total amount of all the teachers of Islamic Senior High School (MAN) in Banjarmasin is 185 from 3 different schools.

Based on Sugiyono (2008) Sample is a part of amount and characteristic owned by population. The sample must be taken from the represented population. The sample used Proportional Random Sampling technique that is used Slovin formula that is:

$$n = \frac{N}{1 + N(e^2)}$$

Notes:

N = The Amount of Population n= The Amount of sample

e= trust level 0, 05

Based on Slovin formula above, the sample of the research is following:

$$n = \frac{N}{185}$$

$$n = \frac{}{1 + 185(0.05)^2} = 127$$

The researcher take the total population of Islamic School Teacher (MAN Teachers) N= 185, error deviation 5%, so the researcher have sample 127 teachers for being the sample of this research.

## III. RESULT AND DISCUSSION

### A. The Relationship between Work Motivation and Service Quality

Questionnaire survey results are processed into data tested for normality and homogeneity before entering the hypothesis testing stage. Data is assessed to meet the distribution of normal distribution and fulfill homogeneity so that it can proceed to the next testing phase. If normality and homogeneity test have been fulfilled, hypothesis can be tested. The Result of hypothesis is shown by the Table 1 below.

**Table 1:** Correlation between Work Motivation and Service Quality

**Correlations**

| | | Y | X1 |
|---|---|---|---|
| Y | Pearson Correlation | 1 | ,893** |
| | Sig. (2-tailed) | | ,000 |
| | N | 127 | 127 |
| X1 | Pearson Correlation | ,893** | 1 |
| | Sig. (2-tailed) | ,000 | |
| | N | 127 | 127 |

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the table above, it can be seen that the Sign value is 0,000. Because sign 0.000 <0.05 then $H_0$ is rejected. Thus it can be concluded that there is a relationship between work motivation and Service Quality. To determine the strength of the relationship between work motivation variables and teacher performance can be seen from Pearson Correlation, based on calculations obtained by Pearson Correlation of 0.893 which shows a very strong relationship.

### B. The Relationship between TIK Perspectives and Service Quality

After analyzing the correlation test, the following results are obtained:

**Table 2:** Correlation between ICT Perspective and Service Quality

**Correlations**

| | | Y | X2 |
|---|---|---|---|
| Y | Pearson Correlation | 1 | ,954** |
| | Sig. (2-tailed) | | ,000 |
| | N | 127 | 127 |
| X2 | Pearson Correlation | ,954** | 1 |
| | Sig. (2-tailed) | ,000 | |
| | N | 127 | 127 |

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the table it can be seen that the Sign value is equal to 0,000. Because sign 0.000 < 0.05 then $H_0$ is rejected. Thus it can be concluded that there is a relationship between TIK perspectives and service quality. To determine the strength of the relationship between variables using TIK and service quality can be seen from Pearson Correlation, based on calculations obtained by Pearson Correlation of 0.954 which shows a very strong relationship.

C. Relationship between Work Motivation and ICT Perspective Together with Service Quality

To determine whether or not there is a relationship between work motivation and ICT perspective together with service quality is done through the calculation of multiple correlation. The results of testing the correlation between each variable can be seen in the table below.

**Table 3:** Correlation between Motivation and Perspective of ICT with Service Quality

**Correlations**

| | | X1 | X2 | Y |
|---|---|---|---|---|
| X1 | Pearson Correlation | 1 | ,945** | ,893** |
| | Sig. (2-tailed) | | ,000 | ,000 |
| | N | 127 | 127 | 127 |
| X2 | Pearson Correlation | ,945** | 1 | ,954** |
| | Sig. (2-tailed) | ,000 | | ,000 |
| | N | 127 | 127 | 127 |
| Y | Pearson Correlation | ,893** | ,954** | 1 |
| | Sig. (2-tailed) | ,000 | ,000 | |
| | N | 127 | 127 | 127 |

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the table above it is known that the correlation coefficient of teacher work motivation with service quality (rY.1) is 0.893 (very strong correlation), ICT perspective with service quality (rY.2) is 0.954 (very strong correlation), and work motivation teacher and utilization of ICT (r1.2) together with service quality is equal to 0.945 (very strong correlation) and a significance value of 0.000 < 0.005 then $H_0$ is rejected. Based on the calculation of the correlation of 0.945. Means together there is a significant relationship of independent variables (motivation and utilization of ICT) with the dependent variable (Service Quality) acceptable. The results of the R square multiple regression analysis are 0.945. This means that 94.5% changes in service quality variables are influenced by changes in work motivation variables and ICT perspective.

## IV. CONCLUSIONS

Based on the result of research, data processing, and discussion, so that the result of the research can be concluded as follows: (1) There is significant relationship between teacher work motivation with the use of TIK at Islamic Senior High School in Banjarmasin; (2) There is a significant relationship of the use of TIK with the quality service of Islamic Senior High School (MAN) in Banjarmasin; (3) There is significant relationship teacher work motivation and the use of TIK continuously with quality service of teaching and learning process at Islamic Senior High School (MAN) in Banjarmasin.

## REFERENCES


Arikunto, Suharsimi. 2003. *Prosedur Penelitian, Suatu Praktek.* Jakarta: Bina Aksara. Arikunto, Suharsimi. 2010. *Managemen Penelitian.* Jakarta: Rineka Cipta.

Haddad, Wadi D. 2005. *Education Police-Planning Process: an Applied Framework.* Paris: UNESCO-International Institute for Educational Planning.

Hadi, Sutrisno. 1999. *Methodology Research.* Yoyakarta: Yayasan Penerbit Fakultas Psikolog UGM.

Mulyadi. 2004. *Akutansi Managemen Konsep, Manfaat dan Rekayasa.* Jakarta: Salemba Empat.

Sidi, Indra Djati. 2003. *Menuju Masyarakat Belajar.* Jakarta : Logos.

Sugiyono. 2008. *Metode Penelitian Kunatitatif Kualitatif dan R&D.* Bandung Alfabeta.

Uno, H.B. 2007. *Teori Motivasi & Pengukurannya analisis di Bidang Pendidikan.* Jakarta: PT. Bumi Aksana.

# 9. Analysis of Science and Mathematics Development of Early Childhood

Noorhapizah, Siti Aisyah, Sutarto Hadi
Lambung Mangkurat University, Banjarmasin, Indonesia

**ABSTRACT**

Research objectives: 1) Science learning planning in developing math skills of children aged 4-5 years old, 2) Implementing science learning in developing math skills of children aged 4-5 years old, 3) Evaluating science learning in developing the math skills of children aged 4-5 years old. This research used observation method. Results of the research: 1) Planning science learning in developing children math skills, the plan was: teacher prepared daily activities plan, worksheet, material to be delivered, media, assessment sheet and class setting. 2) Learning, the initial activities was teacher and children doing morning gymnastics, the core activity was children were first asked to do math activities related to science such as distinguishing objects that could float and sink in water, 3) Evaluation of science learning implementation in developing children math skills, namely by question and answer method and retelling material method that had been studied. It can be concluded that the real science learning could improve children Math skills.

Keywords: Science Learning, Learning Mathematics Motivation for Children

## 1. INTRODUCTION

According to (Sujiono, 2007), early childhood is the foundation of early growth and development that will then affect the next stage of life. Early childhood also requires readiness for further basic education. Arnold, Bartlett, Gowani, & Merali (2007) explain that transition is a period of time when children are in preschool program until elementary school. School readiness is the main key to the success of school transition (Vernon-feagans & Blair, 2006).

School readiness term is used to describe the requirements for children in order to make a successful transition from preschool to formal school (Cuskelly & Detering, 2003). Janus et al. (2007) state that school readiness is the child skills to meet the school work requirements (Janus & Offord, 2007). Snow (2010) adds that school readiness is a state of children competence when entering school, which is important for future success (Snow, 2010).

School readiness tends to focus on children social and academic competencies which are deemed necessary to be ready for learning (Mashburn & Pianta, 2016). School readiness is useful for predicting achievement at the beginning of learning at school (Konold & Pianta, 2005). Lemelin et al. (2007) state that school readiness is related to a child minimum level of development to respond to school demands through cognitive, social and emotional quality (Lemelin et al., 2007), so children who are not ready for school experience academic and behavior difficulties at school compared to their peers who are more ready for school (Konold et al., 2005). Lack of school readiness is a strong prediction of work difficulties, crime, and psychological disorders (Keating & Hertzman, 1999).

According to Government Regulation no. 58 of 2009 on Early Childhood Education Standard, there are 3 key points in cognitive development, which are related to general knowledge and science, related to shape, color, size and pattern and related to the concept of numbers and letters.

According to (Utami et al., 2013), science is knowledge acquired through learning and proving or knowledge that covers a general truth of natural laws that occur by obtaining and proving using scientific methods. Science learning must involve aspects of knowledge, affective and psychomotor. This is in line with the opinion of (Barenthien, Lindner, Ziegler, & Steffensky, 2018) that in realizing a quality science learning process, teachers need skills that include science-specific content knowledge (concept and inquiries) and pedagogical content knowledge.

Science is the process of thinking carried out by humans so that they get answers to everything that happens in nature and its properties. This is in line with the statement by (Andersson & Gullberg, 2014) that the main purpose of science learning in children is to provide an understanding of science concepts.

The method used by teachers in Science Learning in Developing Children Math Skills was field trip learning method, investigation, project-making

method, experimental and exploration methods. This is in accordance with the opinion of Siry (2012) who states that science learning in Kindergarten uses an inquiry approach, children are involved in planning, exploring and sharing ideas. Children are encouraged to collaborate with friends and learn in their own way.

Science teaching materials are arranged based on inquiry flow. Experiments conducted by children with the guidance of the teacher will become a learning experience. This is in accordance with the opinion of Paciorek (2008) who states that "children learn best when interacting in a rich environment". When children interacts with environment surrounding them, they will get a learning experience that is always attached to them. Hornby (2011) defines parental involvement as a participation in education process and experience of their children.

According to Suyanto (2005), Science Learning in Developing Children can train them to use five senses, link cause and effect, teach them to use measuring tools, discover and understand the events and understand the concept of object and calculation.

According to Ismail (2006), children prefer teaching material composed of colored images. Results of the survey by Ade Dwi Utami (2013) on 320 teachers from 1,995 kindergarten teachers in Semarang showed that 80% of them thought that teachers experienced special obstacles in learning science and mathematics. About 80% of teachers experienced problems in selecting science and math learning strategies, 80% of teachers experienced difficulties in assessment, and 78% of teachers experienced difficulties in compiling scenarios of Science Learning in Developing Children Math Skills. Most teachers used worksheets and drawings to introduce science and mathematics. These results mean that the implementation of science and mathematics learning in kindergarten experienced problems.

The implementation of science and mathematics learning in early childhood requires careful planning. Ena Subaenah, Director General of PAUDNI (Non-Formal and Informal Early Childhood Education Programs) of Ministry of Education and Culture of 2014, stated that Science Learning in Developing Children Math Skills in early childhood has been carried out for a long time, but the implementation was still limited in terms of practice. The implementation of science and mathematics learning in early childhood experienced several obstacles related to the learning implementation. These obstacles including many

children education institutions that had not taught science and mathematics and many teachers used worksheets rather than using practical tools, so students only worked on orders rather than making things. Teachers must improve learning methods to be more varied and interesting for children. Teachers shall be prepared to use fun methods such as telling stories and playing.

TK Baitul Ma'mur is one of the kindergarten institutions implementing center model and providing meaningful science and simple math experiments. TK Baitul Ma'mur was established in 2006 where TK Baitul Ma'mur implemented 6 centers, namely literacy center, preparation center, natural material center, block center, role center and Imtaq (Faith and Devotion) center. Teachers provided science and math activities in the center according to the theme taught. Then sub-theme was derived from theme to provide learning for children. For example, when the theme was learning symbol of numbers, the activities were clamping plate according to number to be learned, threading straw selected according to the number mentioned by children, counting numbers by putting the ball into the basket according to the number, counting numbers using sticks, as well as observing floating and sinking objects for science subject.

Science Learning Activities in Developing Children Math Skills were carried out before and during the center learning activities. Science experiment activity was arranged in the form of experimental activities plan. These activities help introducing children to objects used in science experiment activities and were given an understanding of the concepts in science experiment. Teacher provided an activity in the form of an experiment to dissolve some of the materials. The materials were in the form of plastic ball and stone. The children carried out an experiment by putting the ingredients in a bucket of water. v introduced tools and materials and gave an explanation of events occurred during the experiment.

The school provided facilities to support the Science Learning in Developing Children Math Skills, such as buckets, water, and other supporting materials to study science and mathematics, references for experimental activities, science and math reading books, and science worksheets for children. Based on the explanation, this research discusses "Science Learning in Developing Children Math Skills at TK Baitul Ma'mur Landasan Ulin."

Science Learning

Sujiono (2007) explains that the approach to early childhood education and kindergarten learning is carried out based on a program of activities that have been arranged so all children behaviors and basic skills can grow at its best.

Gie (in A. Nugraha, 2006) revealed that planning is an activity that describes in advance the things that must be done and how to do it in achieving a predetermined goal. Learning implementation is an interactive activity between teachers and students that is ended with an evaluation process of learning outcomes. Learning evaluation or assessment is a way to measure the cognitive implementation, success, and development as well as the problems associated with learning outcomes expected from children (Sujiono 2007).

Juwita Yulianti (2010) in Playing While Learning Science in Kindergarten explains that science is a product and process. As a product, science is the body of well-organized knowledge about the physical and natural world. As a process, science is an activity of tracing, observing, and conducting experiments.

According to Whiterington (1979), playing has a function to facilitate the development of children cognition and allow children to see the environment, learn something, and solve the problem faced.

Development of Early Childhood Math Skills

Gardner's mathematics logical intelligence properties (Umar, 2009) states that intelligence includes three interconnected fields namely mathematics, science, and logic. In short, it is skills in mathematics development. Yus (2011) states that the mathematical logical intelligence is related to the children skills as follows: playing words, pointing and naming four to six colors, matching the same objects, drawing people with two to six known parts, and understanding the concepts of function and time.

(Sriningsih, 2009) states that mathematics learning standards refer to ten standards set by NCTM (2003), namely algebra, geometry, measurement, data analysis and probability, problem solving, reasoning and proof, communication, as well as number and operation.

Definition of Simple Experiment

Suyanto (2005) states that experiment is a very suitable thing for children in early childhood because they have a high curiosity. Children can carry out the experimental activities about observing objects that can float and sink in water.

According to Roestiyah (2001), a simple experiment is one of the learning activities where children carry out experiments on a matter, conduct observation on the process, and write down the results of experiment. Djamarah (2006) states that experimental method is a way of presenting lessons where students carry out experiments and find concept of what they are learning.

Roestiyah (2001) proposes the steps of experimental method implementation namely: teacher explains the purpose of experiment, tools and materials used, teacher supervises children during activities and provides suggestions or ask questions to support children skills and collect the results of their research, opens a discussion, and evaluates them by giving a test or question and answer. According to Sudjana (2006), the steps of experimental method implementation are: preparation or planning, experiment implementation, and follow-ups.

## II. METODOLOGY

This research used direct research approach. The research type was observation. This research used observational study as it thoroughly explored the introduction of science through simple experiment activities in Science Learning in Developing Children Math Skills at TK Baitul Ma'mur.

Research Subjects and Objects

The subjects in this research were Teachers and Children of TK Baitul Ma'mur at Jalan Sukamara Landasan Ulin. The research object was the introduction of science and mathematics through simple experiments.

Method used in this research was descriptive method. The data were obtained by active observation, interview, and documentation. Sources of the data included (1) informants, like teachers and principal, (2) learning activities in introducing math and science, (3) classroom management, and (4) documents that included daily lesson plan and student learning outcomes.

## III. RESULTS AND DICUSSIONS

To obtain a clear data about implementation of Science and Mathematics development introduction to children in early childhood at TK Baitul Ma'mur, the researchers came at the school to conduct interviews and direct observations regarding implementation of Science and Mathematics introduction learning. Observations were carried out by observing the teacher and stu-

dents in doing activities. The following were general steps in the learning process applied in the classroom.

Prior to the lesson, teacher had prepared RPPM (weekly lesson plan) and RPPH (Daily Lesson Plan) in order to facilitate the learning process in accordance to 2013 curriculum that had been arranged.

Mathematics and Science Learning

The meeting was carried out based on Daily Activity Plan (RKH) at TK Baitul Ma'mur. The theme for the day was vehicles with mathematical activity, which was an introduction to the symbol of numbers from 1-10 and introduction to science with experiment activity of floating and sinking objects with the following steps:

Initial activities. To create a conducive learning condition; the +children carried out motoric activities of singing before entering the class. After they did activities at the yard, they entered the classroom, then the teacher greeted them, prayed, sang the names of numbers, clapped hands about the number symbols and continued with conversation related to the theme.

When discussing the theme about land transport type such as car, teacher explained the framework of activities, types and equipment, the children were asked to observe car toy carried by the teacher, then teacher and children asked and answered questions about cars.

At the core activities, teacher introduced number 1- 10 through several activities, namely: 1) putting the ball into a basket as many as the number mentioned on the basket, 2) clamping the geometric shapes with clamps according to the number mentioned, 3) threading straws that were later given a number according to the number of straws threaded, 4) naming numbers by sticking the stick. For science activities, the teacher introduced floating and sinking objects. Teacher introduced the objects and tools used. Teacher gave an explanation before conducting the experiment. Teacher also gave answers to questions raised by children regarding the experimental activities, then the teacher exemplified activities to be carried out, explained the game rules, and arranged small groups of three students. Children were asked to do all the activities provided in turns.

In the closing activities, children sat in a circle. Teacher asked the children feelings after the game and explored their experiences after playing. Teacher concluded the activities that have been carried out. Teacher

asked children to say "Alhamdulillah" (all praise is due to Allah) as a sign of gratitude after playing the game.

Teacher and children prayed before eating and children washed their hands with soap. Then they ate together. After eating the teacher encouraged children to be able to tidy up their equipment independently, praying after eating, and then the teacher invited them to play outside the classroom. During the preparatory activity, teacher invited children to gather to tell the theme/activity for the next day, then teacher invited them to sing and prayed to go home and encouraged them to be able to take their bags and personal equipment independently to take them home.

The learning stages in the classroom are as follows: initial activities, core activities and closing.

Initial Activity

Children made a circular formation in an open yard. Together with the teacher, children performed motor activities through motion and song.

At the beginning of the activity before children went to school, teachers prepared activities to be carried out. When they arrived, the teacher greeted and addressed the children. Children were asked to place items brought from home in the space provided. After they gathered, the teacher and children prepared and sang on the yard, conducted gross and fine motoric warm up. Early childhood development of children skills could be seen. Then the teacher must be able to stimulate the development and growth of children.

The implementation of early childhood education learning according to National Minister of Education Regulation No. 58 of 2009 (Ministry of National Education 2009) is carried out by (1) arranging the playground, and (2) organizing activities that include: (a) opening (b) core activities, and (c) closing. The learning process covers the field of behavioral and basic skills development. Development of the two fields is carried out through playing activities both indoor and outdoor as well the habituation activity. The habituation development is carried out when children arrived, played, during the transition, until the children went home. This is in accordance with a research by Pala (2011) who states that characters are not automatically formed, but are developed over time through continuous processes.

Early childhood is defined as groups of children who are in the unique process of growth and development. They have specific growth and development patterns according to their growth and development level (Mansur, 2005).

According to many neurological research, it was found that 50% of child intelligence was formed during the first 4 years. In 8 years old, brain development reached 80% and at the age of 18, it reached 100% (Suyanto, 2005).

Elizabeth B. Hurlock (Hurlock, 1978) states that motor development is defined as the development from maturity element in controlling the movement of body and brain as the center of motion. According to Daeng Sari (1996), fine motor is motoric activity that involves the activity of small or fine muscles. This movement demands eye and hand coordination and good control of motion, which enables it to carry out precision and accuracy in motion.

Kartono (1995) states that the factors influencing children motor development are heredity, environment, and children activity. Rumini (1995) states that the factors accelerating or slowing down fine motor development are genetic of individuals, health and nutrition, stimuli, protection, premature, individual abnormalities, culture, and regional regulation.

Gross motoric is the body ability to use large muscles. Most or all members of the gross motor body are needed so children can sit, kick, run, go up and go down, and so on (Sunaryo, 2007). The function of gross motor development in kindergarten children (Depdiknas, 2009) includes the following: a. Training the flexibility and coordination of finger and hand muscles. b. Encouraging the growth and development of children physical/motor, spiritual and health. c. Forming, building, and strengthening children body. d. Training skills/agility of movement and thinking of children. e. Improving children emotional development.

Praying

When praying began, not all children prayed. There were some children were silent, laughing, and smiling. Every teacher reprimanded them with a sign and there were children who understood and there were also those who ignored the warning, which made regular prayer was stopped for a moment. Not all children raised their hands. There were still those who were lazy to raise their hands, children who played their hands by rubbing on the floor, as well as children who folded their hands and used them to disturb friends next to them.

According to WJS Poerdarminta “prayer means request (wish, praise) to God.” M. Arif Hakim argues that “prayer is a human effort to reach God, to communicate with an invisible being, the creator of all things, the highest wis-

dom, the highest truth, and the greatest power, the redeemer of the sins of every human being" (Hakim, 2004). Moral education expert Lickona (2013) mentions that there are at least 6 characters, namely: honesty, compassion, courage, kindness, self-control, and diligence. Dimerman (2009) identifies 10 characters that must be developed, namely: respect, responsibility, honesty, empathy, fairness, initiative, courage, perseverance, optimism and integrity.

Core activities

At the core activities, children threading straws, attached sticks to the numbers and put balls in the basket, clamped geometric objects and conducted simple experiments of floating and sinking objects.

Threading activity served to develop fine motor skills of the students. The results of research at TK Baitul Ma'mur proved Jamaris' opinion that the coordination movement that can develop fine motor is to make beads or perform threading activities. This research also supports the results of research by Lestari (2016) on Effect of Media- Based Assignment Method in the Pattern Recognition Skills of Group B Children. Here, the use of straws as learning media was success to stimulate the child development other than cognitive aspect. So that there is a connection between threading activities using straw and fine motor skills of group B children at TK Baitul Ma'mur. When considering Dynamic system theory by Thelen and Smith, the research results at TK Baitul Ma'mur showed that was there was new motor skills of children in which children performed threading activities not in accordance with the direction but they created new steps to reach the goal so the strap could fit into the hole. The teacher exemplified by inserting the strap from bottom with five beads. However, there were children who did it by inserting a strap from the top of the hole, and children who threaded by licking the rope first to easily insert it into the hole.

Then there were several children who sticking the stick on the paper with number 1-10, which was useful for doing mathematics for children in early age. Aynur (2011) concludes that a good character is not formed automatically, but it is developed over time through a continuous process of teaching, model learning, and practice, this is developed through character education.

Game is one of the most important activities in life. Through game, children can learn to be active, creative, and innovate to create new things (Berk, 2008). In fact Vygotsky (in Berns, 2010) says that game is an activity

that can stimulate children to recognize the rules of society, know morals, and know how to overcome various kinds of problems that occur in life. This is in line with the social competencies that illustrate children skills to control emotion and establish good relation with others (Baron & Byrne, 1997). Playing can improve social competence, which is defined as a number of skills related to emotional recognition, adaptability, and ability to manage themselves (Xinyin, C. Dan, Li Li, & Liu., 2000).

A research conducted by James (2001) on "Enhancing science education for young children" can be concluded as follows: The main challenge faced by teachers is how they can help children to develop the knowledge, skills and attitudes required to become the scientifically literate people.

Closing activity

In the closing activities, children sat in a circle, the teacher asked children feelings after playing and explored children experience after playing. Then teacher gave the opportunity for children to share their experiences of playing in turns, then teacher concluded the activities that had been carried out, teacher asked children to say Alhamdulillah as a sign of gratitude after playing.

The closing activity is a calming activity. Some activities that can be done in the closing include: 1) Making simple conclusions from the activities that have been carried out, including the moral message to be conveyed. 2) Advices that supports good habits. 3) Reflection and feedback on the activities that have been carried out. 4) Carrying out calming activities such as singing, reciting poetry, and telling encouraging stories. 5) Informing learning plan for the following meeting.

Next is the research results on the Science Learning Implementation in Developing Math Skills of Children Aged 4-5 Years Old in Early Childhood Education at TK Baitul Ma'mur.

Planning for the Science Learning Implementation in Developing Math Skills. Interview was carried out by asking questions about Planning for the Science Learning Implementation in Developing Math Skills at TK Baitul Ma'mur. The researchers conducted an interview with a teacher named Mrs. Maryati who said that the planning must be prepared in advance and it consisted of making the daily activity plan (RKH); preparing learning material and learning media. In Yulianti (2010), "Playing While Learning Science in Kindergarten", the learning resource and media in Early Childhood Education were materials including equipment to provide information and skills to students and

teachers to obtain and enrich the knowledge and prepare several student worksheets (LKS).

The Science Learning Implementation in Developing Math Skills. The researchers interviewed teacher. Mrs. Maryati who said that to conduct learning without any obstacles, teachers usually made rules, such as: children were not allowed to fight for the tools and toy materials, children should have not interfere their friends when studying science.

Evaluation of Science Learning Implementation in Developing Math Skills. The interview was carried out by asking questions about evaluation. The results of the interview as expressed by Mrs. Maryati. She explained that evaluation was conducted by question and answer regarding the material that had been delivered by the teacher, and during learning the teacher used a checklist to determine children cognitive development, and teacher always gave star for children work and once in a while the teacher also gave rewards to children. This is to motivate children's learning.

## IV. CONCLUSSIIN AND RECOMENDATIONS

The planning that must be prepared is as follows, first teachers have to prepare the material namely: worksheet, daily activities plan, children's assessment sheet, class setting, and media to be used to be delivered to the students. The implementation of science learning in developing Children Math Skills among others: carrying out initial, core and final activities. Evaluation of the science learning implementation in developing Children Math Skills is carried out by question and answer or tell about the materials that have been delivered by reviewing the learning that has been taught.

It is hoped that the teachers will always carry out mathematics learning by implementing science learning so mathematics learning delivered to children will always be fun for according to their development level. As the organizers of Early Childhood Education programs, the schools should provide facilities and infrastructure for a more supportive learning process. For future researchers, since the results on the science learning implementation in developing Math skills of children aged 4-5 years are success, it is expected that future research can address the problems about mathematics with different and more interesting media.

**ACKNOWLEDGMENT**

The researchers would like to express gratitude toward the Head of Early Childhood Education Teaching Master Program and the lecturers in the Head of Early Childhood Education Teaching Master Program namely, Mr. J. Dalle, S.Pd, S.Si, M.Kom, Ph.D who had supervised the researchers since the beginning of the research until this article is complete. The researchers would also like to express gratitude toward the principal of TK Baitul Ma'mur Mr. Imam Sadikin and the board of teachers Mrs. Mariati, S.Pd. In addition, the researchers would like to express gratitude to the research team, Nopi Ariansyah, Siti Aisyah and Riska Halidah and the board of editor who provided the opportunity for the researchers to publish this research results. May all individuals who have helped and supported the researchers since the beginning of the research until the publication of this article are blessed by God the Almighty.

**REFEENCES**

A. Nugraha, Sumama, & A. Purwanto. (2006). *Analisis Frekuensi dan Pola Dasar Frekuensi Gender Laras Slendro.* Yogyakarta: FMIPA UNY.

Andersson, K., & Gullberg, A. (2014). What is science in preschool and what do teachers have to know to empower children? *Cultural Studies of Science Education*. 9(2). 275–296. https://doi.org/10.1007/s11422-012-9439-6

Arnold, C., Bartlett, K., Gowani, S., & Merali, R. (2007). *Is everybody ready? Readiness, transition and continuity: lessons, reflections and moving forward.*

Aynur, P. (2001). The Need For Character Education. *International Journal of Scocial Science and Humanity Studies*. 3(2). 24-34. http:// www.sobiad.org/eJOURNALS/journal_IJS S/...2/aynur_pala.pdf diakses pada tanggal 26 Desember 2018.

Barenthien, J., Lindner, MA, Ziegler, T., & Steffensky, M. (2018). Exploring preschool teachers' science- specific knowledge. *Early Years* 5146. 1–16. https://doi.org/10.1080/0957514 6.2018.144332

Baron, R.A., & Byrne, D. (1997). *Social Psychology.* Massachusetts: Allyn and Bacon.

Berk, L.E. (2008). *Exploring Lifespan Development.* Boston: Pearson Education, Inc.

Berns, R.M. (2010). *Child, family, school, community: socialization and support.* California: Wadsworth.

Cuskelly, M., & Detering, N. (2003). Teacher and Student Teacher Perspectives of School Readiness. *Australian Journal of Early Childhood, 28 No. 2.*

Daeng Sari, Dini, P. (1996). *Metode Mengajar di Taman Kanak-Kanak.* Jakarta: Depdikbud.

Depdiknas. (2009). *Permendiknas No. 58/2009 tentang standar Tingkat Pencapaian Perkembangan.* Jakarta: Depdikbud.

Dimerman, S. (2009). *Character is The Key.* Canada: Wiley.

Djamarah, Syaiful Bahri. (2006). *Strategi Belajar Mengajar.* Jakarta: PT Rineka.

Hakim, M. Arif. (2004). *Doa Doa Terpilih Munajat Hamba Allah Dalam Suka Dan Duka.* Bandung: Marja.

Hornby, G. (2011). *Parental Involvement in Childhood Education (Building Effective School-Family Partnerships).* XIV 137. New York: Spinger-Verlag.

Hurlock, Elizabeth, B. (1978). *Perkembangan Anak.* Jakarta: Erlangga.

Ismail, A. (2006). *Education Games.* Yogyakarta: Pilar Media.

Watters, James, J., Diezmann, Carmel M., Grieshaber, Susan J., & Davis, Julie M. (2001). Enhancing science education for young children: A contemporary initiative. *Australian Journal of Early Childhood 26(2)* pp. 1 7.http:eprints.qut.edu.au/ diaksespada tanggal 26 Desember 2018.

Janus, M.A., & Offord, D.R. (2007). Development and Psychometric Properties of the Early Development Instrument (EDI): A Measure of Children's School Readiness*, 39 (1), 1–22. https://doi.org/10.1037/cjbs2007001

Kartini Kartono. (1995). *Psikologi Anak (Psikologi Perkembangan.* Bandung: Mandar Maju.

Keating, DP, & Hertzman, C. (Eds.). (1999). *Developmental health and the wealth of nations*. New York: Guilford Press.

Konold, T.R., & Pianta, R.C. (2005). Empirically- Derived, Person-Oriented Patterns of School Readiness in Typically-Developing Children: Description and Prediction to First-Grade Achievement Typically-Developing Children: Description and Prediction to First-Grade Achievement, (January 2015), 37–41. https://doi.org/10.1207/s1532480xads0904

Lestari, R., & Iskandar, Dudi Sabil. (2016). *Mitos Jurnalisme*. Yogjakarta: Andi.

Lickona, T. (2013). *Pendidikan Karakter Panduan Lengkap Mendidik Siswa Menjadi Pintar dan Baik*. Terjemahan Lita S. Bandung: Nusa Media.

Mansur. (2005). *Pendidikan Anak Usia Dini dalam Islam*. Yogyakarta: Pustaka Pelajar.

Paciorek, K.M. (2008). *Taking Sides: Clashing Views in Early Childhood Education*. New York: The Mc Graw – Hill Companies.

Pala, A. (2011). The Need For Character Education. *International Journal of Social Science and Humanity Studies*. 3(2). 23-32.

http://www.sobiad.org/eJOURNALS/jounal _IJS S/aynur _pala.pdf diakses pada tanggal 26 Desember 2018.

Roestiyah, N.K. (2001). *Strategi Belajar Mengajar*. Jakarta: Rineka Cipta.

Rumini, S. & Sundari, S. (1995). *Perkembangan anak dan remaja*. Jakarta: PT Rineka Cipta.

Siry, C. (2012). Towards multidimensional approaches to early childhood science education. *Cultural Studies of Science Education*. doi: 10.

Snow, KL (2010). Early Education and Development Measuring School Readiness: Conceptual and Practical Considerations. (April 2015). 37–41. https://doi.org/10.1207/s15566935eed1701

Sriningsih, Nining. (2009). *Pembelajaran Matematika Terpadu Untuk Anak Usia Dini*. Bandung: Pustaka Sebelas.

Sudjana, Nana. (2006). *Penilaian Hasil Proses Belajar Mengajar*. Bandung: Remaja Rosdakarya.

Sujiono, Y.N., dkk. (2007). *Metode Pengembangan Kognitif*. Jakarta: Universitas Terbuka.

Sunaryo, & Sunardi. (2007). *Intervensi Dini Anak Berkebutuhan Khusus.* Jakarta: Depdiknas.

Suyanto. (2005). *Konsep Dasar Anak Usia Dini.* Jakarta: Departemen.

Hamzah B., Uno, & Umar, Masri Kudrat. (2009). *Mengelola Kecerdasan Dalam Pembelajaran, Sebuah Konsep Pembelajaran Berbasis Kecerdasan.* Jakarta: PT. Bumi Aksara.

Utami, Ade Dwi, dkk. (2013). *Modul Pendidikan dan Latihan Profesi Guru.* Malang.

Utami, Ade Dwi, dkk. (2013). *Modul Plpg pendidikan anak usia dini*. http://sertifikasi. fkip.uns.ac.id/modul/PAU D/1% 20PAUD.pdf.

Vernon-feagans, L., & Blair, C. (2006). Measurement of School Readiness Measurement of School Readiness, 9289 (June). https://doi.org 10.1207/s15566935eed1701

Whiterington. (1979). *Educational Psychology.* New York: Ginn.

Yulianti, Dwi. (2010). *Bermain Sambil Belajar Sains di Taman Kanak-kanak.* Jakarta: PT Indeks.

Yus, Anita. (2011). *Model Pendidikan Anak Usia Dini.* Jakarta: Kencana Yulianti.

# 10. Developing a Learning Decimal Counting Operation in the 4th Grade of Elementary School Students in the Context of a Floating Market

Karim, Agni Danaryanti, Sutarto Hadi
Lambung Mangkurat University, Banjarmasin, Indonesia.

**ABSTRACT**

This study aims to develop a learning design of the decimal numbers counting learning on the fourth-grade of elementary school students in the context of the floating market. The mathematical learning in the context of the floating market is an effort to present the real-life context to the students or the students' mind. Thus, the given mathematical problems would be easier to understand by students. The method used in this research is the Research and Development Method with the 4D model by Thiagarajan including the steps of Define, Design, Develop, and Disseminate. On this learning development, the approach used was the scientific approach. The result of the study shows that there are five steps in learning design namely (1) let's observe, (2) let's try, (3) let's discuss, (4) let's study, (5) let's practice. The result implies that the learning will be more effective and meaningful if it uses the surrounding contexts of the students to present a real situation in the learning process.

Keywords : mathematical learning; the context of floating market

## I. INTRODUCTION

According to Gagne, mathematics consists of direct and indirect objects. Mathematics as a direct object is described into facts, concepts, principles, and skills. Meanwhile, as an indirect object, mathematics is the characteristics which can be grown on students after they learn it [1]. For students to be able to master the direct and indirect objects of mathemat-

ics, teachers' roles in designing mathematics learning is needed. Regarding mathematics learning in the elementary school, it should receive serious attention from teachers. It needs to be emphasized because there are different characteristics between the essence of students who are learning in elementary school and mathematics itself as a science. In general, elementary school students are not able to think formally, while mathematics itself is a deductive, axiomatic, abstract, and formal science. Thus, a teacher should become a bridge who reduce the gap.

In order to develop mathematics learning in the school, there are six basic principles needed to pay attention at to achieve a high-quality mathematics education; those are equality, curriculum, teaching, learning, assessing, and technology. To develop mathematics learning, the learning principle according to NCTM is the students have to learn mathematics with understanding and actively develop new knowledge from experiences and previous knowledge [2]. Then, in order to develop the learning design, besides paying attention to basic principles, the use of a context is also needed, so students will be easier to understand the given mathematics problems. According to Polya, understanding the problems is an important step for students to solve the problems which they face [3]. De Lange stated that there are four kinds of contexts which can be used, those are students personal, school, social, and scientific context [4]. Besides the principles of learning and the use of context, the employed learning approach must also be the focus of attention. One of the learning approaches recommended in the 2013 curriculum is scientific approach. Scientific approach is a learning approach that uses scientific steps and principles in learning. Teachers must consider four important components in using the scientific approach, namely fostering a sense of wonder, encouraging observation, pushing for analysis, and requiring communication [5]. In the implementation on the learning process, these four components are described into observing, asking, information collecting, associating/reasoning, and communicating.

On the learning of decimal counting operation, most teachers are facing difficulties in teaching students to make them understand the concept well and actively involve in the learning process. This implies on the low understanding of the 4th-grade elementary students towards decimal counting learning operation. To help students understand the concept and be able to do the operation, it needs a learning innovation. The previous research studies on the

learning innovation of the issue had been done by [6] and [7]. Both studies respectively developed the learning design on decimal counting operation using PMRI approach and design of decimal numbers through the decimal wheel.

This study which aims to develop the learning of addition and subtraction of decimal numbers counting operation using the social context of the floating market in Banjarmasin City is needed to conduct so the conceptual understanding and the students are actively involved in developing new knowledge from the existing knowledge. The development of decimal numbers counting operation of addition and subtraction using social context is a new study. The goal of this study is to achieve the learning design of addition and subtraction of decimal number counting operation using the social context of the floating market. The impact of this study is the increase in students' conceptual understanding and skills on decimal numbers counting operation of addition and subtraction and the growth of students' active learning.

## II. METHOD

This study employed a 4D model of research and development by Thiagarajan consisting of Define, Design, Develop, and Disseminate steps [8]. The learning approach used in this study is the scientific approach. The effectivity test was implemented to the 4th-grade students of Islamic elementary school Sabilal Muhtadin Banjarmasin consisting of 32 students. Before the tryout was conducted, the learning design was already validated by two experts in the field.

On the define step, the basic competency study on the 2013 curriculum for 4th-grade elementary school students as well as the study of the materials which are considered difficult by teachers in teaching it was analyzed. On the design step, a draft of learning design was made consisting of the learning plan, students' learning materials, props, and evaluation material. On the developing step, the validated draft was tested in to find the effectivity. The final step is the disseminating step. On this step, the learning design and its props have already multiplied and used by the teachers in the research setting.

## III. RESULT AND DISCUSSION

The learning development of decimal counting operation consists of addition and subtraction. This learning is developed using the scientific ap-

proach which includes observing, trying, associating/reasoning, collecting information, and communicating. The learning context in this study is the floating market on Alalak Tengah Street, Northern Banjarmasin and Piere Tandean Street, East Banjarmasin. The situation of the floating market can be seen in Fig. 1.

Fig. 1. The floating market situation

The result of learning development achieves five activities, those are 1) let's observe, 2) let's try, 3) let's discuss, 4) let's study, and 5) let's practice. The description of teachers and students' activities for each activity is described as follows.

A. *Activity 1: Let's Observe*

- Before the lesson was started, the teacher prepares the physical and mental condition of the students to study.
- The teacher reminds the students about integers and fractions which had been learned on the previous meeting (associating).
- Students observe four pictures of the floating market which had been prepared using a projector (observing).

· Students discuss the condition of the floating market and types of goods on the boats sell by the sellers (asking, communicating).

· The students group kinds of goods on the boats according to vegetables and fruits (associating).

B. *Activity 2: Let's Try*

· The teacher prepares several scales and types of fruit, according to the types on the pictures. Many fruits which have been prepared by the teachers were according to the weight of respective fruits.

· The students were grouped into several groups. One group consists of 3-4 students.

· Each group receives one scale and one type of fruit (the quantity depends on the weight of the type of the fruit). The type of fruit for each group is different.

· Each group weighs two times. The first weighing involves the quantity of fruit which is different from the second weighing. The weight on the first and second weighing were noted until one number after the decimal (trying).

· Each group adds the weight of the fruit on the first and second weighing. The result is the concept of decimal number addition (reasoning).

· Later, each group weighs again for two times. The first weighing involves several fruits. Then, on the second weighing, the number of fruits on the scale is fewer than the first weighing. The weight on the first and second weighing were noted until one number after the comma (trying).

· Each group writes the weight of the fruit on the first scaling subtracted by the weight on the second scaling. The result is the concept of the subtraction of decimal number (reasoning).

· Each group re-writes tidily using relatively large alphabet on the carton paper (information collecting).

C. *Activity 3: Let's Discuss*

· The representative of each group sticks the carton paper consisting of the result on the whiteboard or the selected places appointed by the teacher (communicating).

· Alternately, the representative of each group reports the weighing activities which has been done, it is continued by explaining their results (com-

municating).

- The teacher encourages for the questions and answers sessions among the groups toward the activity and result achieved by each group (discussion).
- According to the discussion results, the students are able to understand the addition and subtraction operation concept of decimal number (associating).

D. *Activity 4: Let's Study*

- The students return to their seats (ungrouping).
- After the students did the weighing activity, took notes of it, and discussed it, the teacher explains the concept of addition and subtraction of decimal number (associating).
- The students are given two example questions related to the addition of decimal number and two example questions related to the subtraction of decimal number (reasoning).

E. *Activity 5: Let's Practice*

- The teacher asks the students to answer the questions related to the addition and subtraction operation of a decimal number (reasoning).
- After the students finish answering the questions, the teacher with the students discuss the answers of the given questions (communicating).
- The students with the teacher's guidance conclude the lesson (communicating).

The evaluation result of the students' understanding of the addition and subtraction counting operation of the decimal number shows satisfying results. 26 of 32 students who joined the test (81,25%) understand the concept well. The observation towards the students' activities in learning also shows a satisfying result. More than 85% of the students were actively involved in observing, trying, asking, and giving opinions. The expected result from the learning process implementation is already in line with the basic principles stated by NCTM about the learning principles [2]. According to those basic principles, there are two aspects that the teachers have to pay attention in developing the learning. The first is learning mathematics with understanding is something important and not only need calculating skill but also need thinking and mathematical reasoning capabilities. The second, on the mathematics learning in the class, the students

were asked to assess their own and friends' ideas, they were pushed to create mathematical assumptions, test it, and develop their abilities to deliver logical reasoning.

The result of this study is in line with [7] who stated that on the learning of decimal numbers, the game of "decimal wheel" acted as the connector on the addition of decimal number between one number decimal number after the comma or more, and make the students realize about the difference between decimal number system and integer system. Also, it is in line with [6] who stated that using PMRI approach and the context of weighing something that is around the students can help them understand the decimal number and do the addition of it.

## IV. CONCLUSION

Base on result and discussion, it can be concluded that the achieved learning design of decimal number operation consists of 5 steps of activities, those are:1) let's observe, 2) let's try, 3) let's discuss, 4) let's study, and 5) let's practice. The implication of this study is the learning will be more effective and meaningful if using the surrounding context of the students so it can present the real situation of the learning process.

## REFERENCES


[1] F. H. Bell, Teaching and Learning Mathematics. Iowa: WBC, 1978.

[2] NCTM, Principles and Standards for School Mathematics.Reston VA: Arthur, 2000.

[3] G. Polya, How To Solve It. New Jersey: Princeton University Press, 1973.

[4] J. De Lange. Mathematics, Insight and Meaning. Utrecht: OW & OC, 1987.

[5] S. Mc Collum. Character Education: Managing Conflict Resolution. New York: Chelse House, 2009.

[6] L. Maimuna, Darmawijoyo, E. Susanti, "Pembelajaran penjumlahan bilangan desimal konteks pengukuran berat berdasarkan pendekatan PMRI," Jurnal Review Pembelajaran Matematika, JRPM, vol. 3, no. 1, pp. 1-17, 2018.

[7] E. A. Afriansyah, “Penjumlahan bilangan desimal melalui permainan roda desimal,” Prosiding Seminar Naional Matematika dan Pendidikan Matematika FMIPA UNY, 2013, pp. 233-240.

[8] S. Thiagarajan, D. S. Semmel, M. I. Semmel, Instructional Development for Training Teachers of Expectional Children. Minnesota: Leadership Training Institute, University of Minnesota, 1974.

# 11. Dilemma Between Applying Coherent Principle and Signaling Principles In Interactive Learning Media

Baharuddin[1], Sutarto Hadi[2], Abdul Hamid[3], Ariffin Abdul Mutalib[4], Juhriyansyah Dalle[5].

Universitas Negeri Medan, Medan, Indonesia[1,3]. Universitas Lambung Mangkurat, Banjarmasin, Indonesia[2,5]. Universiti Utara Malaysia, Kedah, Malaysia[4].

**ABSTRACT**

*Background:*

Studies on developing multimedia content for eLearning have widely been conducted. In previous studies, multimedia learning contents were developed without applying any principles, making them less efficient in supporting user's mental effort. To this end, this study extends the current state by applying the coherence principle and signaling principle to make the multimedia learning content usable and interesting to use. Furthermore, the paper aims at describing the dilemma when applying both principles together.

*Materials and Methods:*

In this study, a four-phase methodology has been used. First, a prototype has been developed by applying the coherence principle and signaling principle. Following the development, five experts were consulted for identifying flaws in the developed prototype through a walkthrough session.

*Results:*

Finally, this paper showcases the flaws gathered by the experts for further improvement.

Keywords: Coherence principle, Signaling principle, Interactive learning media, Learning, Multimedia content, Dilemma.

## I. INTRODUCTION

Teaching and learning activities have now gone beyond the classroom. In a digital environment, the learning ecosystem comprises a learning management system, a learning content management system, and a learning object.

The technologies supporting the learning and teaching processes have become so advanced thus enabling anyone to have learning opportunities. As a response to such advantages, various works have been conducted for enriching learning experience. As an example, Aziz *et al.* [1] and Dalle *et al.* [2] made the multimedia learning content simpler through the simplicity principle for visually-impaired learners in schools. Meanwhile, Dolhalit *et al.* [ 3] applied the persuasive principle in their multimedia content that makes society aware of the danger of truancy among school students. While previously, Tosho *et al.* [4] and Elkabani and Zantout [5] coined a model for multimedia learning content for inclusive users. In fact, multimedia has been used also in teaching practical skills [2, 6], assisting people in learning practical tasks in extremely-crowded situation [7] and teaching culture [ 8]. While they evolve from different forms, the society forgets that such technologies actually prepare them for facing the learning paradigm in the fourth Industrial Revolution (IR4.0) [9, 10]. In general, the IR4.0 requires designers to be highly creative in providing solutions [11, 12]. In IR4.0, the learning and teaching processes have been largely improved by the multimedia technology [13].

Besides the fact that learning activities are diversified (as described in the studies in the previous paragraph), the learning contents are also made easily understandable and more attractive through the use of multimedia technology [14, 15]. As an instance, an extremely fast-moving object is presented in a slow representation. It has also been seen that abstract concepts (such as photosynthesis and respiration) can be represented in a concrete form. Furthermore, it can support educators in case of dangerous or rare phenomena that are difficult to be presented in class. In fact, Mayer [14] goes beyond that in which he expressed that multimedia technology supports various tasks for enabling learning takes place in a virtual environment.

Multimedia contents or interactive learning media must be tailored for intended users. Moreover, its context of use must be carefully considered. Without a proper design and development procedure, it will not successfully achieve its goals in its desired context. In this regard, Cooper *et al.* [16] expressed that designers have to focus on the learning experience. When there are too many difficulties in utilizing the learning materials, users tend to get frustrated [17] and such experience could disengage users with the learning content and learning activities.

In Indonesia, the government invests hugely in the education sector

[18]. However, the teaching and learning technologies, including multimedia learning content, have to be wisely designed so that they do not go against human rights [19, 20]. Aspired to be at par with teachers in developed countries, the government also concerns with teachers' ability. Hence, it has been underlined in the main thrusts of the national agenda, which implies that each education level must possess a high quality of teaching and learning practice. This requires the co-operation of all teachers, especially regarding their teaching duties [20, 21] because learners have different types of intelligence [22, 23]. Considering Multiple Intelligence, one of the intelligences is, for example, visual intelligence, which argues that there are people who learn best through visual representations. In response to that, this study believes that multimedia learning will benefit students in their learning process [24]. It is especially applicable to topics that contain processes and step-by- step procedures, including learning mathematics.

Works on making learning mathematics interesting through multimedia contents have been widely conducted. In their recent study, Parera *et al.* [ 25] and attracted learners through digital creative games, as opposed to earlier approaches as of Chorianopoulos *et al.* [ 26], that used serious games. Even though both studies use games, their connotation is different. Nevertheless, both have shown a positive impact towards learning mathematics. Meanwhile, Chao-Fernández *et al.* [27] utilized music in making learning mathematics interesting.

The multimedia learning content has been used in supporting not only the needs of normal learners but also learners with special needs. This is shown in recent works of Ávila-Soto *et al.* [28] and Ma▪ kowski *et al.* [29]. Meanwhile, Ahmad and Mutalib [30] designed a courseware for low-achieving learners. However, in the above-mentioned studies, authors have not reported the application of certain multimedia design principles. As it is shown in this study, without applying multimedia principles, the learning users do not experience the learning contents as they desire. Furthermore, they become cognitively tired and exhausted because they are dealing with audio and visual elements. When their cognitive is inappropriately loaded, their attention is disrupted, which negatively affects their learning process. The present study presumes that when multimedia design principles are applied, the courseware would better assist the learners.

Regarding multimedia learning content for learning mathematics, Sweller

*et al.* [ 31] considered that reduced cognitive and minimized load is potentials for promoting user's engagement in using multimedia content. One of the famous ways to ensure this fact is to apply certain principles in the multimedia learning system design [32]. In response to that, this study applies in the design process two of the multimedia learning principles [33], which are recommended by Mayer and Fiorella [34] and Mayer *et al.* [35], namely the signaling principle and the coherent principle. In general, the coherent principle recommends that multimedia learning content should rather be simple, not complex. In contrast, the signaling principle recommends that important parts of the multimedia learning contents should be highlighted or supported with certain instructional technique [36]. This study involves a scientific and systematic process [37, 38] for designing and developing the multimedia learning content while considering an expert review upon the developed multimedia learning in accordance.

All the above-mentioned discussions highlight the importance of multimedia use in supporting the learning process. However, ensuring users' satisfaction when using the multimedia learning system is another issue. Accordingly, this study attempts to design a multimedia learning system related to mathematics content to be used in secondary schools in Indonesia. For the purpose of this study, the content has been decided by the school teachers. Based on their experience in teaching mathematics for more than 8 years, the fraction topic is appropriate because it is not too difficult and has the potential to be understood by all learners.

This section states the aim of this study and discusses the background, including the problem that this study solves. A detailed explanation of the research procedure is enclosed in the next section, which is followed by the results and findings. Finally, this paper ends with a conclusive discussion regarding the way this study impacts the context of the study.

## II. METHODOLOGY

To achieve the proposed aim, this study involves a set of activities, which cover three stages, as shown in Fig. (**1**) (Interactive Triangulation Methodology), namely requirement analysis, development, and evaluation. Every stage requires iterations of processes, which demand triangulations for the data source and methods.

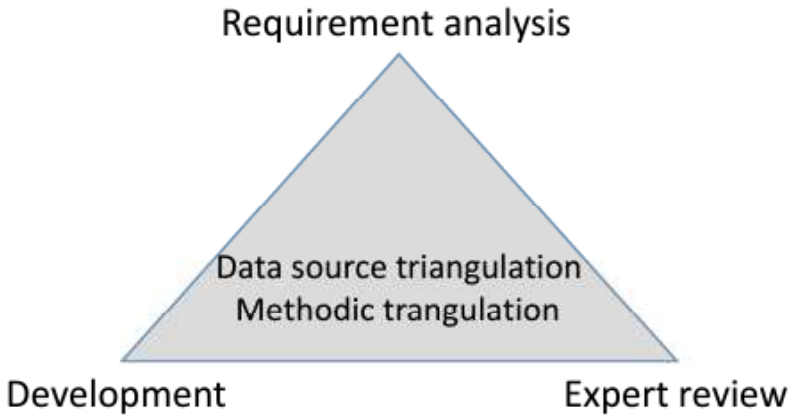



Fig. (1). Iterative triangulation methodology.

>Data source triangulation: This study gathers data from different timings, locations, and people. This increases the possibility of revealing typical data or the potential of identifying similar patterns, thus increasing confidence of the findings.

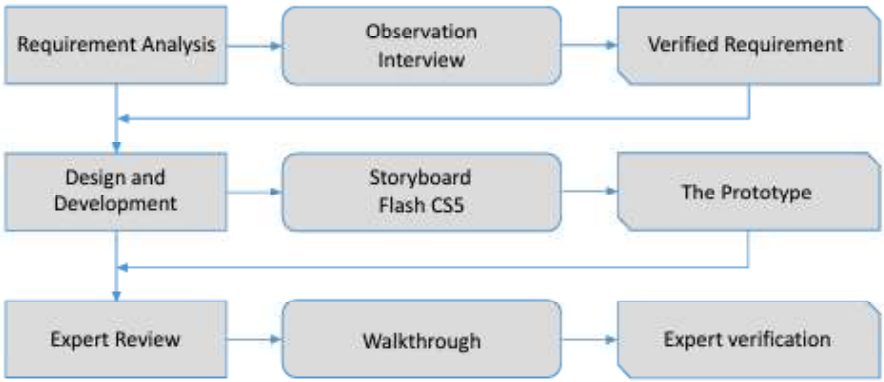
>Methodology triangulation: This could also be called mix method or multi-method and can be considered in both data collection methods and research methods. The use of different methods provides richer information to the study.

Furthermore, Fig. (**2**) visualizes the steps conducted throughout the research work mapped with the study deliverables.

Referring to Fig. (**2**), it is observed that the requirements were gathered through interviews and observations. Basically, based on the problem, this study observed the teaching and the learning process within class hours for five different schools. It was found that teachers use conventional means and the pupils (learners) do not engage in the process. The mediums relate only to chalk-and-board and books, for which learners show no excitement. After a few observation sessions, the teachers were interviewed as for the purpose of the study. The interviews were held in the corresponding five schools and two to three teachers were involved in each school. The purpose of interviewing the teachers was to gather their opinion on the use of visual representation (multimedia learning application) for their teaching and learning process, as a complemen-

tary medium to books. Additionally, it was aimed to gather inputs if they agree with the idea of utilizing multimedia learning application for learning mathematics.

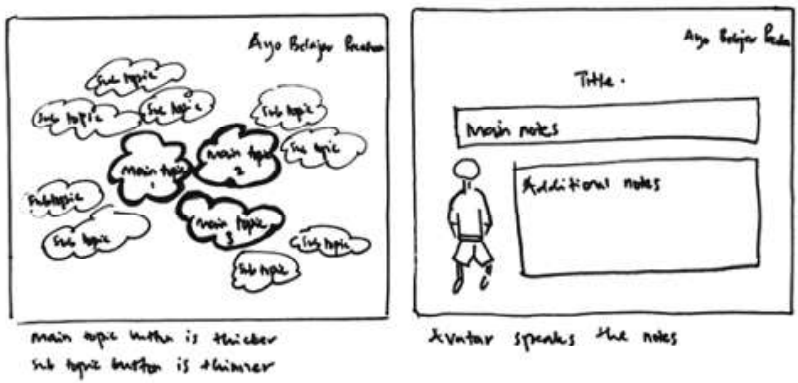
Fig. (2). Research procedure.




The teachers uncontestably accepted the idea of utilizing multimedia learning content for their teaching and learning purpose. In further discussions, the teachers agreed to select the fraction topic as a starting point. The topic was selected as it is not very difficult, it is famous and provides the potential for all learners to understand the concept. Given this fact, it is likewise a good strategy to familiarize them with the multimedia learning content considering other topics later on. Starting with a favorite topic could ensure learners' interest towards the multimedia learning content and further support their knowledge.

After the teachers were interviewed, this study interviewed a group of learners within each school to gather their requests related to the way they expect the multimedia learning content to support them in their learning. The interviews were also held in the schools where they study and between 13 and 17 learners from each school took part in this study. Although some learners were not sure about the format of the learning content, the majority expressed their preference for a courseware, no matter if it is online or offline. They had no idea on how the multimedia learning system should look or act, but only that it must be user-friendly. This implies that the learning content has to be in Bahasa Indonesia.

Fig. (3). Sample of the storyboard.




The results of the observations and interviews set the requirements for the multimedia learning content. It is clear that users need an interactive multimedia for content learning that provides information on the fraction topic. They want to access the learning content from any location and at any given time. While the focus is to make the multimedia learning content usable for the users, the fraction content for this study was taken from the standard textbooks used in schools. Particularly, multimedia learning content should minimize users' cognitive load by minimizing assessments.

Based on the requirements gathered in Phase 1, this study designed the visual interface and the ambience of the multimedia learning content in Phase 2. Storyboard (the sample is available in Fig. (3) was used to locate ideas into concrete representations. It was necessary to ensure that quick responses could be gathered from users: teachers and students.

The alternative designs of storyboards were presented to users in a cyclical process, for them to give their comments and feedback on the designs. Providing alternative designs is necessary for the users to have opportunities to compare and express their responses as a reference to the designs, rather than having to think without any point of reference. The sample in Fig. (3) represents the finalized design.

When the design was selected, a working prototype was developed. Macromedia Flash 8 was used for developing the multimedia learning content. It is appropriate because the learning content contains hybrid interactivity and navigation style. Fig. (4) through Fig. (8) depict the snapshots of the multimedia learning content.

Fig. (4) shows the main menu of the multimedia learning content.

A cloud representation is used for buttons. The cloud signals that they are clickable items. The title of the learning content is placed at the right-top corner of the interface.

Fig. (4). Main menu.


Similar cloud representation is used for selecting the topics, as shown in Fig. (**5**). The figure exhibits different line weights for the clouds contour, wherein a thicker contour represents a parent topic, while a thinner contour shows sub- topic.

**Fig. (5).** Selection of topics.


Fig. (6). Notes.


When notes are included, they are separated into different representations. Main notes are presented without a frame, while additional notes are located within frames, as shown in Fig. (6). This strategy highlights to learners the parts to focus more and where to focus less. Additionally, an avatar explains the notes using audio, with various intonations to highlight important points for the learners.

Fig. (7). Instructions.


When instructions are provided, they are represented in numbered lists, as indicated in Fig. (7). The use of numbered lists enables learners to

systematically organize their learning process in a step-by-step order of actions to be performed. Fig. (**7**) exhibits a page for learners to perform exercises. From this page, the learners are supposed to select an appropriate level of questions to answer. From the figure, it is seen that the buttons clearly state the level of taxonomy for the questions. If learners click the "Uji Kompetensi 1" button, they will be provided with questions of knowledge level only. Meanwhile, the "Uji Kompetensi 2" button provides learners with questions of comprehension level. A similar procedure is considered for the other buttons. This strategy informs the learners about the level of questions they are expected to answer.

Fig. (8). Exercises.


When users click any button, a page appears, as shown in Fig. (**8**). It is seen that the questions and answer options are presented in a scrollable window, with a panel of responses at the bottom. The panel is consistently visible. This strategy is significant to notify the learners on their attempts.

Then, the prototype was reviewed by experts by means of a walkthrough process. The expert walkthrough process aims at determining whether users could easily carry out their tasks. For this study, experts' comments regarding the walkthrough are important, as indicators whether the learn-

ing content could reach learners before being implemented in actual teaching and learning activities. For such purpose, Blackmon *et al.* [39] employed five experts, and they were able to gather saturated feedbacks. Hence, this study adopts their technique, because we believe employing less than three experts is doubtable in terms of maximum feedback, while employing more than five experts may lead to a waste of resources. All experts involved in this study have experienced consulting projects in the industry. At the same time, they have been researching in human-computer interaction and teaching their respective fields for at least seven years. The walkthrough session was conducted as the procedure visualized in (Fig. 9).

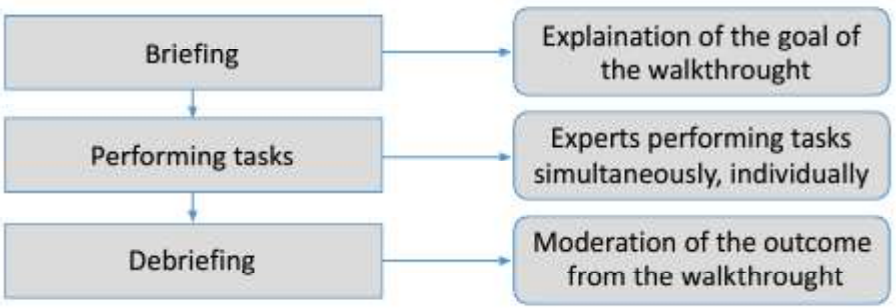



Fig. (9). The walkthrough procedure.

During the day of the walkthrough session, the experts were briefed about the aim of the walkthrough session. They were cleared that at the end of the walkthrough session, they should assemble usability flaws in the prototype, particularly on flaws regarding unnecessary activities that increase cognitive loads. Then, they conducted specific tasks to walk through the multimedia learning content. The tasks are (1) reading the notes about fraction, (2) understanding the instructions, (3) answering the exercise questions, and (4) analyzing their attempts. It was emphasized to the experts that they should note all findings while individually walking through the session. The expert provided their consent that they were not allowed to discuss during the walkthrough. The session was followed with a debriefing session, wherein the experts gathered together and discussed what they found. After brainstorming and moderating the outcomes, they finally provided the conclusions of this study.

## III. RESULTS

The multimedia learning content was developed based on a storyboard designed in a cyclical process, which eventually has been approved by the users. The contents were adopted from the textbook used in schools. When experts walked through the learning content, their concern was focused on whether the prototype supports well the user tasks, through the way it interacts with the users. This refers to unnecessary activities that create cognitive loads, which may lead to negative impacts on user experience.

Having gone through the walkthrough process, the experts found that the multimedia learning content is able to properly deliver the learning contents. However, all experts agree there are some activities in certain parts that may lead to unnecessary user efforts either physically or cognitively. These additional activities are detailed in the following paragraphs.

In the main menu, the real-time date is stated in a cloud (Fig. (10), which could be understood as a button (*excise 1*). This is because all buttons are represented with a cloud formation, and therefore confuses the users. It is similar to the exit button that should be represented in a special representation to notify its impact (*excise 2*). Another fact is that the buttons are not organized (*excise 3*). Users have no order when searching for the desired button to be clicked; hence, they have to visually search the entire interface.

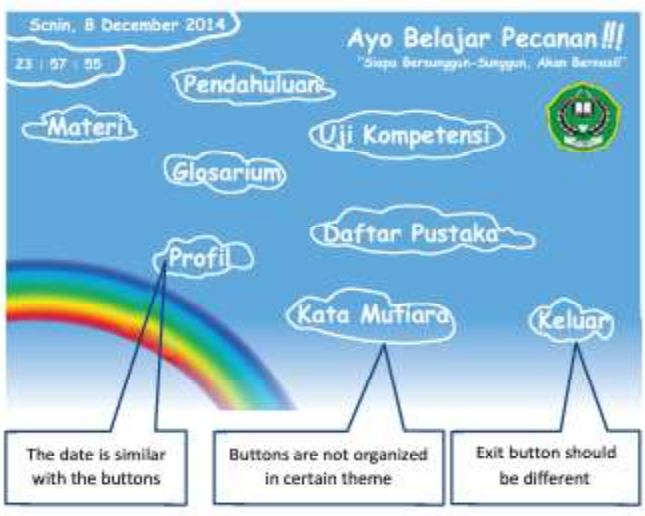



Fig. (10). Excise in main menu.

The buttons for selecting sub-topics are shown in Fig. (**11**). It is observed that the buttons for the parent topic and sub-topic are represented identically, except the outlines for the parent topic, which are thicker (*excise 4*). In such situations, some learners may not give attention to that or some may think that it is merely a mistake. Moreover, all buttons for sub-topics are not organized, similarly as found on the main page (*excise 5*). The buttons are also not associated with their parents. In this case, learners have to think additionally which sub-topics correspond to which parent. To avoid this additional load, topics have to be linked, for example using lines. Some good examples for that are using breadcrumb (in normal websites) or tab (in excel). Furthermore, the menu contains many topics, and therefore it (*excise 6*) should propose the order of topics to the learners so that it makes learners aware of the desired order and the corresponding topic family. This perhaps could be done using colors, shape, size, grouping, or other similar representations.

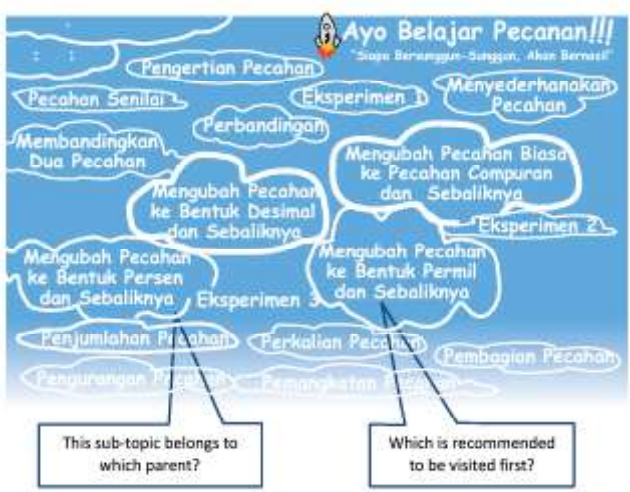



Fig. (11). Excise in sub-topic.

In the notes page (Fig. 12), the title is represented in a cloud, identical with the buttons (*excise 7*). This really confuses learners, because they have associated the cloud with buttons in their mind. The title should be the dominant element in the page, with different colors and larger size, free of cloud. In the pages, the text is white (*excise 8*), which does not bring any emphasis from the

learners' perspective. Hence, learners are not guided by repetition and emphasis. This could be avoided by using color, underline, punctuation, and others.

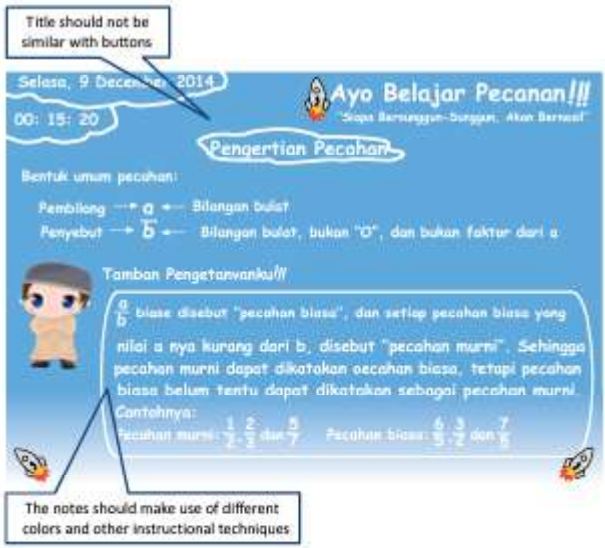



Fig. (12). Excise in notes.

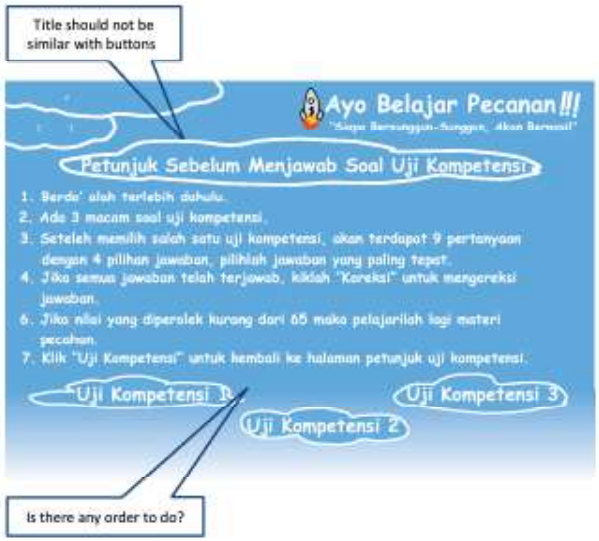



Fig. (13). Excise in instructions.

When instructions are available in the interface, they are represented in a numbered order, as shown in Fig. (13). In general, they are helpful, but the title is similar to buttons (excise 9) and can confuse some learners. At the bottom, there are three buttons intended to enable learners to test their knowledge and understanding about the topics. However, there is no indication related to the order (excise 10); therefore, learners do not know whether there is any order. This may force them to do the exercise in an inappropriate order. Moreover, the instruction lists are plainly white without any emphasis (excise 11). In this situation, learners are not motivated to go through the instructions, as it is desired. To avoid this situation, the use of different color for keywords may help.

In the exercises page (Fig. 14), the use of the windowing approach is excellent, because it can ensure information about user attempts, which is always visible. However, the title looks like a button (excise 12). The questions and options for answers are in white (excise 13), which does not emphasize their meaning. If the options for answers would be in a different color, it may strongly convey its meaning. The level of information within and outside the window is also different. However, in Fig. (14), having similar color and size, they look alike (excise 14). This could be avoided using different size and color.

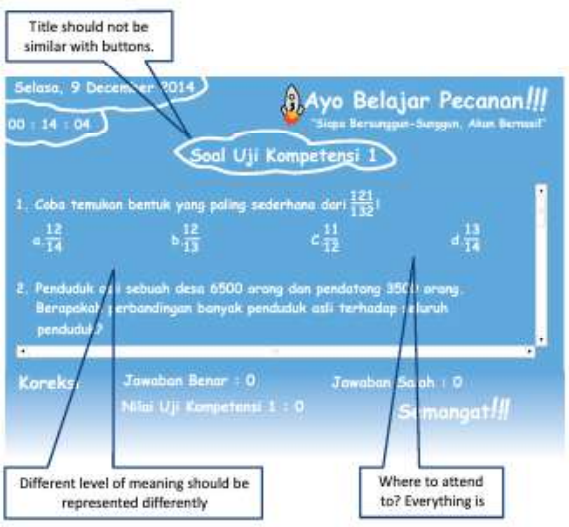



Fig. (14). Excise in exercises.

## IV. DISCUSSION

Involving experts in the design process is crucial for multimedia learning because they can discover flaws that may potentially disrupt the users. As an evidence, the experts in this study discovered 14 additional loading activities through the walkthrough sessions and they believe that there are severe excises regarding coherent and signaling principles that may disrupt learners' attention while learning using multimedia eLearning platform. Other studies have also involved experts in the development of interactive products such as Karajeh *et al*. [40], and Mohd and Shahbodin [41]. They also gathered similar results, wherein expert evaluations discover a number of a flaw in terms of excise in the interactive products.

Besides those 14 severe excises, they also discovered other excises that affect the learners but are not severe. Moreover, excises regarding aspects that are not related to coherent and signaling principles are also discovered (not discussed in this paper).

Although there are excises, the developed multimedia learning content has applied the principles at its best. Obviously, the coherent principle is applied throughout the learning content. By applying the principles, unnecessary remedies are eliminated, which further help learners to focus on the learning content.

Similarly, the signaling principle is applied throughout the learning content. However, the designers are confused between strategies considering the coherent and signaling principles. It is observed that the designer is not confident to use elements for signaling the learners (by applying the signaling principle) to avoid making the display complex (the coherent principle).

Considering experts' feedback, this is a trade-off. However, in case it impacts more positively, let the use of signaling principle harmonizes the coherent principle. In case it is not necessary, follow the coherent principle [34, 35]. Such instructional approach is very important in the learning process because it can determine learners' knowledge [42].

## V. CONCLUSION

Although the design is approved by the users (teachers and learners) through the storyboard, experts still recommend severe excise to be read-

dressed regarding the coherent and signaling principles. This study agrees to the experts' recommendations because they are experienced with numerous projects (as recommended by Preece *et al.* [17] and Mayhew [43]). Based on their experience in dealing with various users and various context, their recommendations are valid.

This study will take appropriate actions accordingly. All excises will be eliminated through appropriate instructional strategies. This will lead to a new design, which will need another expert evaluation, followed by user acceptance as it has previously been conducted within various works [44, 45]. In fact, this is likewise strongly emphasized by experts like Nielsen [46], Preece *et al.* [17], and Schneiderman *et al.* [47].

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

## HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are base of this research.

## CONSENT FOR PUBLICATION

Not applicable.

## CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.


## ACKNOWLEDGEMENTS

This article is extracted from individual research that uses the specially designed multimedia learning tool. On this occasion, the authors expresses their highest appreciation to M. Ali Hasmi who has designed the interface of multimedia learning and also to the rector of Universitas Lambung Mangkurat, Universitas Negeri Medan, and Universiti Utara Malaysia, which provided a wide discussion room to improve the quality of this article.

## REFERENCES


[1] Aziz N, Mutalib AA, Sarif SM. user experience of interactive assistive courseware for low vision learners (ac4lv): Initial round. TEM J 2017; 6(3): 488-96. [http://dx.doi.org/10.18421/TEM63-09]

[2] Dalle J, Hadi S, Baharuddin, Hayati N. The development of interactive multimedia learning pyramid and prism for junior high school using macromedia authorware. The Turkish Online J Educ Techn 2017; 714-21. November

[3] Dolhalit ML, Salam SNA, Mutalib AA, Yusoff MSB. Towards the development of persuasive multimedia model of truancy awareness (PMTA): Review of research. J Eng Appl Sci (Asian Res Publ Netw) 2017; 12(16): 4215-21. [http://dx.doi.org/10.3923/jeasci.2017.4215.4221]

[4] Tosho A, Mutalib AA, Abdul-Salam SN. Conceptual design model of instructional interfaces: Courseware for inclusive education system (IID4C) distance learning. Int J Distance Educ Technol 2016; 14(4): 68-82. [http://dx.doi.org/10.4018/IJDET.2016100106]

[5] Elkabani I, Zantout R. A framework for helping the visually impaired learn and practice math. In: 5th International Conference on Information and Communication Technology and Accessibility; 2015. ICTA 2015 [http://dx.doi.org/10.1109/ICTA.2015.7426909]

[6] Baharuddin, Dalle J. Interactive courseware for supporting learners competency in practical skills Turkish Online J Educ Tech 2017; 16(3): 87-98.

[7] Al-Aidaroos ASA, Ariffin AA. Personal digital mutawwif: A multi-modal mobile hajj assistance using the location based services. Jurnal Teknologi 2015; 77(29): 15-20. [http://dx.doi.org/10.11113/jt.v77.6805]

[8] Walsh T, Petrie H, Odutola O. Developing interactive systems for different cultures: Issues of assessing user experience with visual materials. Proceedings of the 26th Australian Computer-Human Interaction Conference. 470-9. [http://dx.doi.org/10.1145/2686612.2686687]

[9] Li G, Hou Y, Wu A. Fourth industrial revolution: Technological drivers, impacts and coping methods. Chin Geogr Sci 2017; 24(7): 626-37. [http://dx.doi.org/10.1007/s11769-017-0890-x]

[10] Baygin M, Yetis H, Karakose M, Akin E. An effect analysis of industry 40 to higher education Conference Information Technology Based Higher Education and Training (ITHET). IEEE 2016; pp. 1-4. [DOI: 10.1109/ITHET.2016.7760744]

[11] Carter D. Creativity in action–the information professional is poised to exploit the fourth industrial revolution: The business information survey 2017. Bus Inf Rev 2017; 34(3): 122-37. [http://dx.doi.org/10.1177/0266382117722440]

[12] Ward J. Are you ready for the fourth industrial revolution? Aust Min 2017; 108(11): 36-7. [DOI: 10.15265/IY-2016-052].

[13] Munadi Y. Learning media: A new approach. Jakarta: Referensi 2013.

[14] Mayer RE. Using multimedia for e-learning. J Comput Assist Learn 2017; 33(5): 403-23. [http://dx.doi.org/10.1111/jcal.12197]

[15] Aziz N, Mutalib AA, Sarif SM. The design principles of assistive courseware for low vision (AC4LV) learners. J Eng Appl Sci (Asian Res Publ Netw) 2015; 10(3): 1447-56.

[16] Cooper A, Reimann R, Cronin D, Noessel C. About Face: The essentials of interaction design. John Wiley & Sons 2014.

[17] Preece J, Sharp H, Rogers Y. Interaction design: Beyond human-computer interaction. 4th ed. Wiley 2015.

[18] Educational Science Development Team FIP-UPI. Science and Application Education Part 1. Bandung: Imtima; 2007.

[19] Tilaar HAR. Improve national education. Jakarta: Rineka Cipta; 2009.

[20] Usman MU, Setiawati L. Efforts to optimalize teaching and learning activities. Bandung: Remaja Rosdakarya 1993.

[21] Arsyad A. Learning Media. Jakarta: Raja Grafindo Persada 2010.

[22] Gardner H. Frames of mind. New York: Basic Book Inc 1993.

[23] Gardner H. Multiple intelligences: The theory in practice. NY: Basic Book 1993.

[24] Tomita K. Visual design tips to develop an inviting poster for poster presentation. TechTrends 2017; 61(4): 313-5. [http://dx.doi.org/10.1007/s11528-017-0197-x]

[25] Parera H, Hewagamage KP, Weerasinghe TA. Game-based learning as a supplementary approach in teaching mathematics. Proceedings of the 17th Int. Conf. On Advances in ICT for Emerging Regions 2017. [http://dx.doi.org/10.1109/ICTER.2017.8257799]

[26] Chorianopoulos K, Giannakos MN, Chrisochoides N. Design principles for serious games in mathematics. Proceedings of the 18th Panhellenic Conference on Informatics 2014: 1-5. [http://dx.doi.org/10.1145/2645791.2645843]

[27] Chao-Fernández R, Román-García S, Chao-Fernández A. Art, science and magic: Music and math the classroom. Proceedings of the 5th International Conference on Technological Ecosystems for Enhancing Multiculturality 2017. [http://dx.doi.org/10.1145/3144826.3145427]

[28] Ávila-Soto M, Valderrama-Bahamóndez E, Schmidt A. Tan Math: A tangible math application to support children with visual impairment to learn basic arithmetic. Proceedings of the 10th International Conference on Pervasive Technologies Related to Assistive Environments 2017: 244-45. [http://dx.doi.org/10.1145/3056540.3064964]

[29] Ma▪ kowski M, Brzoza P, {▪ abka M, Spinczyk D. Multimedia platform for mathematics' interactive learning accessible to blind people. Multimedia Tools Appl 2018; 77(5): 6191-208. [https://doi.org/10.1007/s11042-017-4526-z]. [http://dx.doi.org/10.1007/s11042-017-4526-z]

[30] Ahmad SZ, Mutalib AA. Integrating learning techniques into iCAL4LA-Bijak matematik courseware to motivate low achieving children in learning. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 2017. [http://dx.doi.org/10.1007/978-3-319-70010-6_40]

[31] Sweller J, Ayres P, Kalyuga S. Explorations in the learning sciences, instructional systems and performance technologies. Springer New York 2011. [DOI: 10.1007/978-1-4419-8126-4_7]

[32] Clark RC, Mayer RE. E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning. John Wiley & Sons 2016. [http://dx.doi.org/10.1002/9781119239086]

[33] Butcher KR. The multimedia principle In the cambridge handbook of multimedia learning. 2nd ed. New York, NY, US: Cambridge University Press 2014.

[34] Mayer RE, Fiorella L. Principles for reducing extraneous processing in multimedia learning: Coherence, signaling, redundancy, spatial contiguity, and temporal contiguity principles.The Cambridge handbook of multimedia learning. New York: Cambridge University Press 2014. [http://dx.doi.org/10.1017/CBO9781139547369.015]

[35] Mayer RE, Heiser H, Lonn S. Cognitive constraints on multimedia learning: When presenting more material results in less understanding. J Educ Psychol 2001; 93: 187-98. [DOI: 10.1037//0022-0663.93.1.187]. [http://dx.doi.org/10.1037/0022-0663.93.1.187]

[36] Majumdar A. design principle of using multimedia in elearning Retrieved from 2016.https:// elearningindustry.com/ 10-design -principles- using-multimedia- in-elearning. 22 March 2018

[37] Mayer RE. Multimedia learning. 2nd ed. New York: Cambridge University Press 2009. [http://dx.doi.org/10.1017/CBO9780511811678]

[38] Mayer RE. Instruction based on visualizations.Handbook of Research on Learning and Instruction. New York: Routledge 2011.

[39] Blackmon MH, Polson PG, Kitajima M, Lewis C. Cognitive walkthrough for the web. Proc of Conference on Human Factors in Computing Systems 2002. 463-70. CHI 2002 [http://dx.doi.org/10.1145/503376.503459]

[40] Karajeh W, Hamtini T, Hamdi M. Designing and implementing an effective Courseware for the enhancement of e-learning. International Journal of Emerging Technologies in Learning 2016; 11(4): 70-6. [http://dx.doi.org/10.3991/ijet.v11i04.5384]. [http://dx.doi.org/10.3991/ijet.v11i04.5384]

[41] Mohd CKNCK, Shahbodin F. Design and development of a multimedia courseware using personalized learning environment approach for nutrition topic. J Eng Appl Sci (Asian Res Publ Netw) 2016; 11(18): 10714-20. [DOI:10.4018/978-1-60566-208-4.ch011].

[42] Straková J, Simonová J, Greger D. Improving mathematics results: Does teachers' academic optimism matter? A study of lower secondary schools. Sch Eff Sch Improv 2018; 1-18. [https://doi.org/10.1080/09243453.2018.1446449].

[43] Mayhew DJ. The usability engineering lifecycle. San Francisco: Morgan Kaufmann 1999. [http://dx.doi.org/10.1145/632716.632805]

[44] Aziz N, Roseli NHM, Mutalib AA. Visually impaired children's acceptance on assistive courseware. Am J Appl Sci 2011; 8(10): 1019-26. [DOI: 10.5042/jat.2011.0096]. [http://dx.doi.org/10.3844/ajassp.2011.1019.1026]

[45] Mayer RE, DaPra CS. An embodiment effect in computer-based learning with animated pedagogical agents. J Exp Psychol Appl 2012; 18(3): 239-52. [DOI: 10.1037/a0028616]. [http://dx.doi.org/10.1037/a0028616] [PMID: 22642688]

[46] Nielsen J. Usability Engineering. Morgan Kaufmann Publishers Inc 1994.

[47] Schneiderman B, Plaisant C, Cohen M, Jacobs S, Elmqvist N, Diakopoulos N. Designing the user interface: Strategies for effective human- computer interaction. 6th ed. University of Maryland 2016.

# 12. Signaling Principles in Interactive Learning Media Through Expert's Walkthrough

Derlina[1], Juhriyansyah[2], Sutarto Hadi[3],
Ariffin Abdul mutalib[4], Candra Sumantri[5]

Universitas Negeri Medan, Indonesia[1,5]. Universitas Lambung Mangkurat, Banjarmasin Indonesia[2,3]. Universiti Utara Malaysia, Malaysia[4].

**ABSTRACT**

This study analyzes the impact of signaling principles upon the effective use of interactive learning media. Normally, designers just design and develop learning media for use in schools without considering the way it eases users' tasks. Bearing in mind that signaling users while they are learning through interactive learning media is important, this study incorporates signaling principles while designing it. Thus, this paper aims to discuss the appropriate signaling principles for learning media from experts' perspective. The Iterative Triangulation Methodology was applied to achieve the aim. Altogether, activities were carried out in three phases: requirement analysis, design and development of the prototype, and expert evaluation using a walkthrough. Results revealed that although the prototype was designed by involving users, experts still discovered a number of flaws in the exercises as a result of not properly applying the signaling principles.

Keywords: Signaling, principles, walkthrough, interaction design, application.

## I. INTRODUCTION

Multimedia has been used in improving the quality of teaching and learning process (Munadi, 2013). It makes learning contents more attractive, easily understood, more varied, and with an increased number of learning activities (Mayer, 2017), which implies in its design (Aziz, Mutalib, & Sarif, 2015). When properly designed,

multimedia learning could transform abstract concepts into concrete; bring the phenomenon of dangerous, rare or difficult to obtain to be presented into the class; present extremely fast-moving objects in a slow representation; allow students to interact directly with the environment; allow uniformity of observations and perceptions for student learning experience; generate motivation to learn; present learning information consistently and can be repeated or stored according to the need; and present the message or learning information simultaneously. In fact, Mayer (2017) goes beyond that, stating that it supports various tasks that enable learning to take place in a virtual environment. It is inline with the requirements of the fourth industrial revolution (4IR), which underline that the use of technology is absorbed into daily life, including education. Every society has to be ready to face it (Ward, 2016).

Considering such advantages, various studies have been carried out for the purpose of enriching the learning experience. As an example, Dolhalit, Salam, Mutalib, and Yusoff (2017) embedded persuasive principle in their multimedia learning in promoting awareness of truancy among disadvantaged students. Elkabani and Zantout (2015), and Aziz, Mutalib, and Sarif (2017) applied simplicity principle in their multimedia learning for visually-impaired learners in schools, while Tosho, Mutalib, and Abdul-Salam (2016) designed a multimedia learning to enhance inclusive education. Walsh, Petrie, and Odutola (2014) used multimedia to teach about culture. It was also used in teaching practical skills (Baharuddin & Dalle, 2017), and in extremely-crowded situations (Al-Aidaroos & Mutalib, 2015), which are part of the initiatives to prepare the society for facing the learning paradigm in the 4IR (Baygin, Yetis, & Karakose, 2016; Li, Hou, & Wu, 2017). One challenge in dealing with the 4IR is the ability to design solutions creatively (Carter, 2017).

Gardner expresses eight different types of intelligence through his Multiple Intelligences theory (Gardner, 1983; Gardner, 1993). One of them is visual intelligence, which argues that some people learn best through visual representation. In response to that, this study argues that multimedia learning will benefit students in their learning process (Tomita, 2017). It is especially applicable for the subjects (like physics) that contain processes involving difficult-to-get materials.

'Physics' originates from Greek, which means "natural." It is part of the science that studies the relevance of physical concepts with the real life, which consists of four dimensions: (1) way of thinking; (2) ways to investigate; (3) knowledge; and (4) its interaction with technology and society (Chiapetta & Koballa, 2006). Many studies have been carried out to support the teaching

and learning of physics. Regarding this, Doyan and Sukmantara (2014) developed an intranet for the physics course. They used the intranet to increase learners' various skills. Similarly, Stankova, Barmasov, Dyachenko, Bukina, Barmasova, and Yakovleva (2016) studied the efficiency of computer technology in learning physics. In fact, Toenders, De Putter-Smits, Sanders, and Den Brok (2017) worked with visually-impaired learners to solve their problems. Those studies focus mainly on providing contents in digital form, with various media representativeness. Besides physics, works in other science streams have also been carried out. As an instance, Aksoy (2012) utilized animation in teaching 7th-grade science and technology course. Meanwhile, Chiang, Yang, and Hwang (2014) used augmented reality, and Fautch (2015) used flipped classroom to enable learners to learn more actively.

However, ensuring learners are happy using the multimedia in learning is another issue. Accordingly, this study attempts to design a web-based learning media (as carried out by Butcher (2006)) for physics for use in schools in Indonesia. For the purpose of this study, static fluid is selected. It has been decided after observing the practices in schools. Through the observation, it was found that laboratories are abandoned, but topics are delivered through conventional lectures. It is because laboratories have limited tools for experiments, besides the inability of the laboratories to support a large number of students. As a result, learners feel bored learning physics topics. Those topics could be best learnt through experiencing them, so that they could visualize the processes and their effects. However, cost really matters in making all tools available. Thus, an alternative solution could be attempted. This could be overcome through the use of media technology, as demonstrated in the work of the researchers discussed in the previous paragraphs.

Designing and developing interactive learning media must be tailored for the intended users, and appropriate for the context of use; who are, in this case, the school learners in Indonesia. Otherwise, such media cannot achievethegoals in thedesired way. The concern of this study is on learning experience, as recommended by Cooper, Reimann, Cronin, and Noessel (2014). Users tend to get frustrated when they experience difficulties in utilizing the learning materials (Preece, Sharp, & Rogers, 2015), hence they do not engage with the learning activities and the learning contents. According to Sweller, Ayres, and Kalyuga (2011), eliminated exercises and reduced cognitive load are among factors that could increase user engagement in using interactive

learning material. Among the famous ways to ensure that is by considering certain principles in designing the product (Clark, 2014). In response to that, this study applies signaling principles in designing the web-based interactive learning media, as recommended by Mayer (2014), and Mautone and Mayer (2001). It is one of the principles in multimedia learning (Butcher, 2014). It has to go through a scientific and systematic process (Mayer, 2009; Mayer 2011). Thus, this paper aims to demonstrate the expert review of the web-based learning media.

This section discusses the background of this study, including the problem to be solved. Next, the research procedure is explaned. Then, the results and findings are presented. Finally, this paper ends with a discussion ofthe impact of this study on the context.

## II. METHOD

This study involves three parts; requirement analysis, development, and evaluation; which require iterations of processes. In fact, there are a number of iterated data sources and methods. To fit these requirements, this research adopts the Iterative Triangulation Methodology. The triangulated data source and methods are visualized in Figure 1. Triangulation is applied in terms of data source, method, theory, and data analysis.

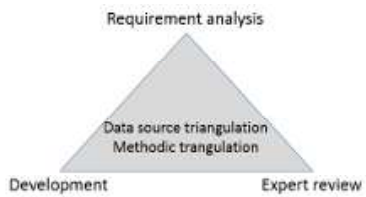



**Figure 1. Triangulation Methodology**

>Data source triangulation–this study gathers data from different time, space, and persons. This increases the possibility of revealing a typical data or the potential of identifying similar patterns, thus increasing the confidence of the findings.

>Methodological triangulation–could also be called mixed-method or multi-method, and can be seen in both data collection method and research method. Use of different methods provides richer information to the study.

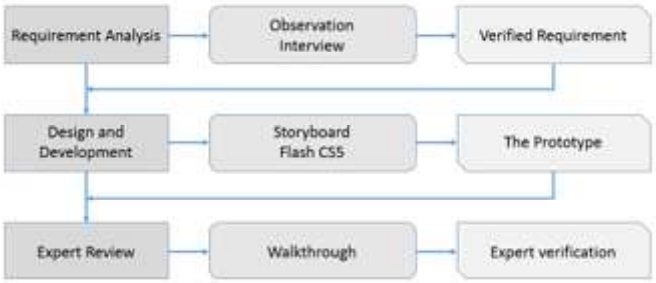



**Figure 2. Research Methodology**

Further, Figure 2 visualizes the steps carried out throughout the research work mapped with the deliverables.

Figure 2 shows that the requirements were gathered through observation and interview. Upon commencement of this study, having understood the problem, as discussed in the Introduction section, this study observed the teaching and learning in the classroom. The teaching and learning practices in three schools in Banjarmasin and three schools in Medan were observed. Prior to the observation, this study made a proper arrangement with the management of the schools. At this point, where the goal of the observation was to understand the current state of teaching and learning practices, observing six schools is sufficient, because the six schools already cover rural and urban areas, running standard curricula by receiving funds from the government. In the observation, it was found that teachers teach in a conventional way, and learners do not participate. It is totally book- based, and learners show no excitement. In each school, after a few sessions of observation, this study interviewed the teachers. The interviews were held in schools, where they teach. Altogether, 19 teachers involved in the interview (between 1 and 3 teachers each school). The aim of the interview was to gather their view on the use of visual representation (multimedia learning application) in their teaching and learning on top of the book. Also, it was aimed to gather additional input to see if they are happy with the multimedia learning application.

Feedbacks of the interview were obviously as expected. The teachers favored the idea of utilizing multimedia learning application for their classroom teaching. In further discussion, the teachers agreed to select static fluid as a start. Particularly, they emphasized that Pascal law, submarine, regional water

company, and principal of Archimedes are the topics that must be made available. It was decided that the topic is hardly explained with a visual representation, especially because it requires special setting and tools. When it could be visualized using multimedia learning application, it could better support their teaching and learners' understanding.

Having interviewed the teachers, this study interviewed the learners, aimed at gathering their views on the way they expect the application to support their learning. As the aim was general, this study selected between 2 and 5 learners each school (eventually this study managed to interview 32 learners). The interviews were also held in schools, where they study. Based on their feedback, they prefer a web-based application so that they could access the learning content anytime anywhere. They have no idea about how the application will look and feel, but they just need an application that is friendly to them.

Based on the results of the observations and interviews, the researchers concluded that the users need an interactive learning media that provides contents on static liquid (particularly on Pascal law, submarine, regional water company, and principal of Archimedes) for them to access any time anywhere. For this study, the content on the static liquid is taken from the textbook, while the focus is to make the learning media usable for the users. Particularly, the learning media should minimize users' cognitive load by minimizing exercises.

Based on the requirements, the prototype was designed. Ideas were put on a storyboard (the sample is available in Figure 3). It was used to elicit feedback from the users.

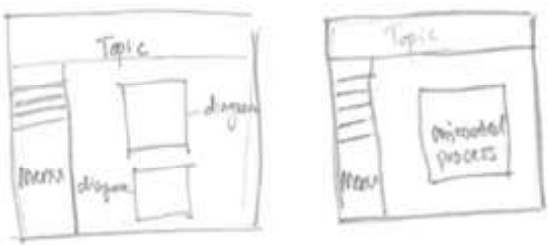



Figure 3. Sample of the Storyboard

The storyboard was presented to the users in a cyclical process, for them to give their comments and feedback on the design. The sample in Figure 3 is the finalized design, in which they prefer an application with windowing and menu interaction style.

Then, the design was transferred into a working prototype. Flash CS5 was used in making animated representations. Figures 4 through 7 depict some of the snapshots of the learning media.

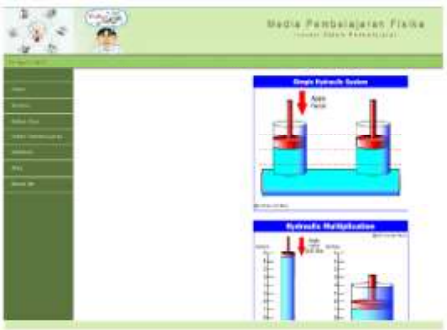


Figure 4. Appearance of Law Pascal Application Menu On Hydraulic Pump

Figure 4 displays the learning media with the navigation panel on the left. The background is made plain, to avoid unnecessary mental processing. The topic remains at the top at all time. In Figure 4, when users click the arrow, a window opens and displays a simulation as seen in Figure 5. The process is represented by colors and text in an enlarged size.

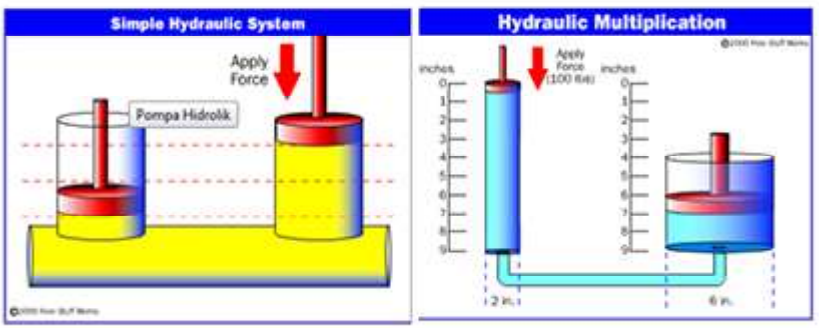



Figure 5. Pascal Legal Applications on the Hydraulic Pump

Figure 6 is a submenu display that shows the phenomenon of Archimedes Principle. In the media the student can observe if the object is inserted into the liquid then the weight of the load will decrease as much as the liquid it displaces, by changing the load inserted into the liquid the amount of water that moves will also vary, thus displaying a different appearance.

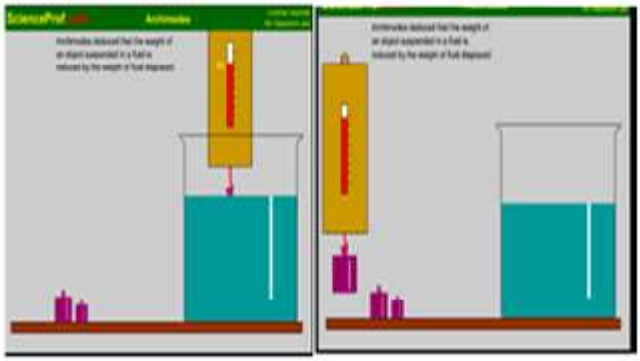


Figure 6. The Archimedes Principle

Figure 7 is a submenu display that shows the application of Archimedes in everyday life especially on submarines, students can observe and manipulate the conditions of floating submarines and diving.

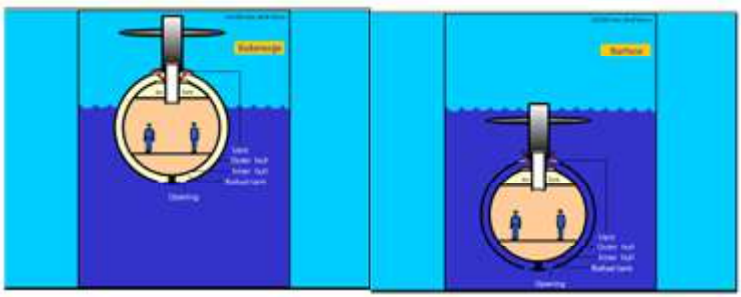


Figure 7. Applications of Archimedes on submarines

Then, the prototype was tested through expert review, in which walkthrough was performed to determine whether through the designed interface users could easily carry out their tasks or not (Blackmon, Polson, Muneo, & Lewis, 2002). Five experts were involved in the walkthrough sessions. All experts had been teaching in the field of human- computer interaction and research for at least seven years. In addition, projects in the industry were also consulted. The procedure for the walkthrough session is visualized in Figure 8.

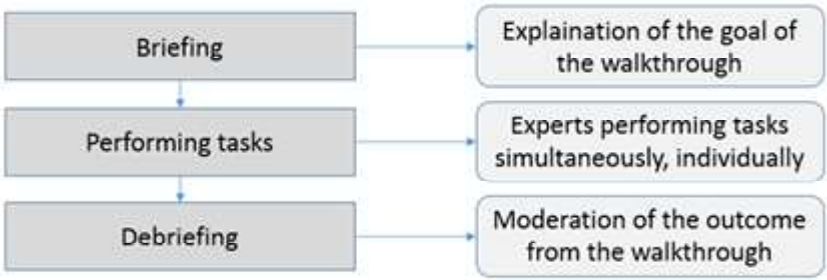


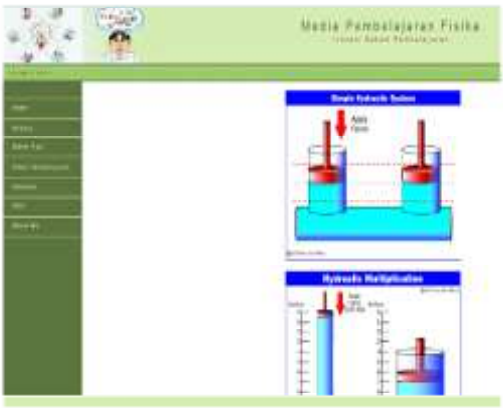
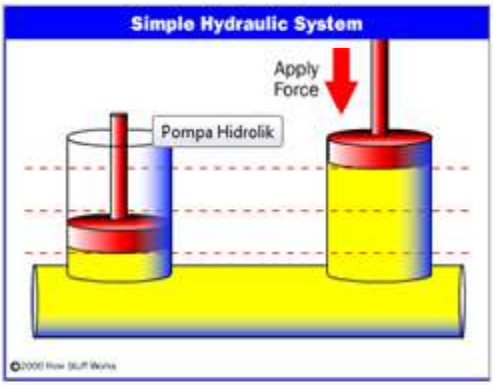

Figure 8. The Walkthrough Procedure

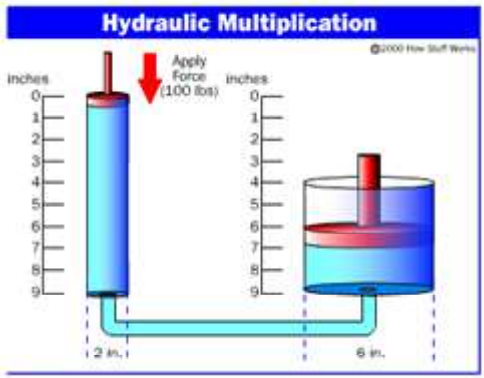
Referring to Figure 8, in the beginning, the experts gathered together and were briefed about the goal of the walkthrough. They were made understood that the walkthrough was aimed at gathering usability issues, particularly on flaws that increase cognitive loads through unnecessary exercises. Then, they were walked through the learning media, guided by specific tasks. The tasks are (1) observe the simulation for Pascal law, (2) observe the simulation for a submarine, (3) observe the simulation for the regional water company, and (4) observe the simulation for the Archimedes Principle. While walking through the learning media, each of the experts noted down all the flaws that they found. They were not allowed to discuss during this walkthrough. Later, in the debriefing session, the experts sat together and discussed what they had found. They brainstormed, and moderated the outcomes. Finally, they handed the outcomes to the researchers of this study.

## III. RESULTS

The learning media was developed based on the storyboard that was designed with user intervention. The contents were adopted from the textbook. When experts walked through the learning media, their concern was whether the prototype, through the way it interacts with the users, support the user tasks well. In this paper, the user tasks being evaluated is related to observing the simulations to understand the content.

Having gone through the walkthrough process, the experts found that the learning media is able to deliver the contents. However, the users face certain difficulties in some tasks. Table 1 details these difficulties in the tasks.

| Display | Excise and Implication |
|---|---|
|  | **Excise 1. There is no instruction for the users.**<br><br>**Implication: When there is no instruction, users have to guess for their action (*can cause cognitive load*). They may make mistakes, or wait for some actions from the learning media (*can lead to stress*).**<br><br>**Excise 2. The arrows have no indication of an active button.**<br><br>**Implication: When there is no indication, users do not realize that they can be clicked for actions from the learning media, hence, they have to guess and may click on other elements (*can cause cognitive load*).** |
|  | **Excise 3. The objects have no label.**<br><br>**Implication: When there is no label, users have to guess. Perhaps, users have to find the information from another source (can cause unnecessary action and cognitive load).**<br><br>**Excise 4. The lines have no label.**<br><br>**Implication: There are three lines, with no label, hence users have to guess which one means what... (can cause cognitive load).**<br><br>**Excise 5. Does the color (for the objects) contain certain meaning?**<br><br>**Implication: Users may think the color is part of the effects of the simulated action. Hence, they tend to think of the effect (can cause cognitive load).**<br><br>**Excise 6. The arrow does not indicate the strength of the force.**<br><br>**Implication: Users have no idea, and they have to make some guesses (can cause cognitive load). Or they understand differently.** |




**Excise 7.** The objects have no label.

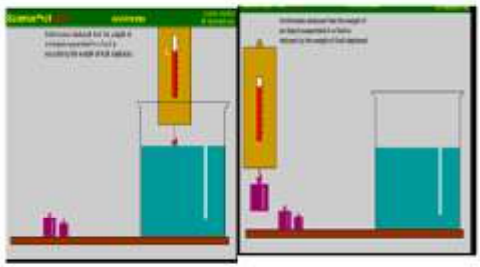
**Implication:** When there is no label, users have to guess. Perhaps, users have to find the information from another source (can cause cognitive load).

**Excise 8.** The experiment seems similar to the simple hydraulic system, but has no line.

**Implication:** Users may wonder in what way the simulation results in (can cause cognitive load).

**Excise 9.** Objects use a different color than that in the simple hydraulic system.

**Implication:** Users may think color means something (can cause cognitive load).

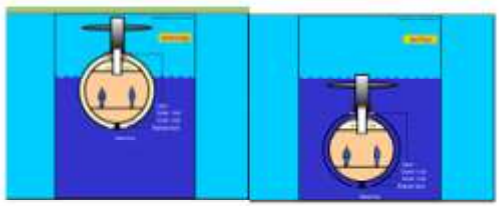


**Excise 10.** The objects have no label.

**Implication:** When there is no label, users have to guess. Perhaps, users have to find the information from another source (can cause cognitive load).

**Excise 11.** There is no indication for user tasks.

**Implication:** Users have to guess their actions (can cause cognitive load).



**Excise 12.** The objects have no label.

**Implication:** When there is no label, users have to guess. Perhaps, users have to find the information from another source (can cause cognitive load).

**Excise 13.** There is no indication for user tasks.

**Implication:** Users have to guess their actions (can cause cognitive load).

**Excise 14.** The label is too small.

**Implication:** Users have to put extra effort into reading the label (can cause cognitive load).

| | |
|---|---|
| Overall | Excise 15. The simulations lack caption explaining the experiment.<br><br>Implication: Users have to rely too much on the visual and audio. The text could strengthen the audio and visual. Hence, without text stating important points, learning could be distorted (could cause cognitive load).<br><br>Excise 16. No example in the actual context.<br><br>Implication: Users may not be able to associate the experiment with the actual context. Hence, they have to guess, or it creates fear for them to experience the actual situation (could cause frustration). |

Table 1. Excise in the Learning Media

## IV. DISCUSSIONS AND CONCLUSION

Although the learning media has been designed by involving users, and their feedbacks were considered, and signaling principles have been applied, still experts found that users will face difficulties understanding contents from the experiments exhibited in the learning media. Based on their experience while walking through the learning media, they suggest actions in Table 2 to be taken.

**Table 2. Recommendations for Improvement**

| | Excise and Recommendation |
|---|---|
| Excise 1. | There is no instruction for the users.<br>Recommendation: Instructions are placed for every experiment. They have to be step-by-step in the language users familiar most, with a placeholder. |
| Excise 2. | The arrows have no indication of an active button.<br>Recommendation: when there are elements users are expected to click, make them noticeable. They have to provide cues, either visual cue or audio cue. |
| Excise 3. | The objects have no label.<br>Recommendation: In all experiments, all objects are labeled. The label should not touch the object, and located on a placeholder. For all objects, the label has to be easily read and standardized (color, shape, font size, etc...) |
| Excise 4. | The indication of effects and results have no label.<br>Recommendation: All indications of effects and results in all experiments should be labeled/captioned. The labels must be represented differently than the labels for objects. They must be standardized for all experiments. |
| Excise 5. | Does the color (for the objects) contain certain meaning?<br>Recommendation: If the use of color is insignificant, use standardized color for all objects. |
| Excise 6. | The arrow does not indicate the strength of the force.<br>Recommendation: When there is a force, indicate the strength of the force, in the text. |
| Excise 7. | The experiment seems like similar to the simple hydraulic system, but has no line.<br>Recommendation: For all similar experiments, with similar form of effects, use similar representation. |
| Excise 8. | Objects use a different color than that in the simple hydraulic system.<br>Recommendation: For all similar procedure of experiments, use similar representations. |
| Excise 9. | There is no indication for user tasks.<br>Recommendation: For all experiments, user tasks have to be clearly indicated, such as whether they have to click something, type something, drag somewhere, and etc... |
| Excise 10. | The label is too small.<br>Recommendation: When providing text, ensure the text is readable by the users. This implies to color, size, location, contrasts, etc... |
| Excise 11. | The simulations lack caption explaining the experiment.<br>Recommendation: On top of audio and visual explanation, text stating main points is necessary. Provide them to enhance memorability. |
| Excise 12. | No example in the actual context.<br>Recommendation: Provide video showing how the context being experimented takes place in the real situation. |

The results of the walkthrough prove that although an interactive learning media is designed with users' involvement, it is not guaranteed flaw-free. Designers have to realize that designing learning media has to be carried out in an interdisciplinary team (Preece, Rogers, & Sharp, 2015). In this study, not only content experts were involved, besides learners, but also experts in human-computer interaction.

Involving experts in human-computer interaction is crucial because they could determine the problems users potentially faced when dealing with the learning media. This could not be performed by other people, including the designer. Based on their experience the human-computer interaction experts have user characteristics in mind already, for the context they are using the learning media. As a result, identifying flaws is easy for them.

Other studies like Karajeh, Hamtini, and Hamdi (2016) and Mohd and Shahbodin (2016) also involved experts in their development of interactive products. Basically, they also gathered similar results, that expert evaluation discovers a number of flaws in terms of excise in their interactive products.

All recommendations by the experts are expressed in ensuring users are notified. This is the role of signaling principles. Obviously, signaling principle is important in guiding users while going through the learning media (Austin, 2009). It helps users in many ways. Besides noting users of buttons and menu, it helps to feed reactions back to users, and notifying the status of tasks being carried out. Also, it clarifies format of entry, and availability of something (Amadieu, Marine, & Laimay, 2011). Obviously, it is more powerful when the interactive application is more complex. Anyway, the learning media in this study is simple; hence, the signals it provides to users are limited. It is in line with the goal of the learning media (and any other interactive application), which is to ease user tasks. Hence, unnecessary signaling is totally avoided.

The interactive learning material in this study acknowledges the roles of experts in human- computer interaction. It is strongly emphasized by many gurus (like Preece, Rogers, and Sharp (2015) and Mayhew (1999)) to employ experts for evaluating the interface of the designed prototype before deployment. Based on the recommendations by the experts, this study will take the appropriate actions in improving the interface.

Further, this study intends to carry out a user test after the prototype is improved. Besides expert evaluation, this study believes that user test is also important before the learning media is deployed, as has been carried out by

various works previously (Aziz, Roseli, & Mutalib, 2011; Mayer & DaPra, 2012). In fact, it is also strongly emphasized by the experts like Nielsen (1994), Preece, Rogers, and Sharp (2015), Schneiderman, Plaisant, Cohen, Jacobs, Elmqvist, andDiakopoulos (2016).

Regarding signaling principles, designers have to understand that too much signaling is also annoying users (Mayer, Heiser, & Lonn, 2001; Mayer & Fiorella, 2014). It is analogous to a person who tells too much, even in situations where people do not expect any information. When the person keeps telling, and others have to respond to it, it is unnecessary. Hence, providing signals to users should be carefully considered, to ensure important signals are not leftunattended, and that no unnecessary signal is loaded.

## ACKNOWLEDGEMENTS

This paper is coming from lecturer-student collaboration research with self-funding. We would like to express our gratitude to Universitas Negeri Medan, Universiti Utara Malaysia, and Universitas Lambung Mangkurat for their support particularly facilities and infrastructures.

## BIODATA and CONTACT ADDRESSES of AUTHORS

**Derlina** is a lecturer at Universitas Negeri Medan, Indonesia. She gained her Master Degree and Doctoral Degree from Universitas Sumatera Utara Medan in 2001 and Universitas Negeri Jakarta in 2012 Indonesia. Now she is the secretariat of graduate program of physics education department Universitas Negeri Medan. Her main research interest is physics education with relating to educational technology.

**Juhriyansyah Dalle** is a lecturer at Department of Information Technology Universitas Lambung Mangkurat, Banjarmasin Indonesia. He gained his Master Degree in Computer Sciences from Universitas Gadjah Mada in 2003, and Doctoral Degree from Universiti Utara Malaysia in 2010. His academic interest areas are Information studies, multimedia content, educational technology and media, area of expertise, human-computer interaction, and usability, computers in education, information system development and applied statistics in education and information technology. He has 5 journal articles published in international indexes, 1 national and 2 international proceedings indexes.

**Sutarto Hadi** is a Professor of Mathematics Education at Faculty of Education Universitas Lambung Mangkurat Banjarmasin Indonesia who has more than twenty years of experience working for teaching mathematics education subjects. Currently he has been assigned as the rector of Universitas Lambung Mangkurat Indonesia. His main area of research interest is realistic mathematics.

**Ariffin Abdul Mutalib** is a lecturer of Multimedia Technology Department, School of Multimedia Technology and Communication, Universiti Utara Malaysia, Malaysia. He hold PhD IT from Universiti Utara Malaysia in 2009 and Master Degree in Interactive Multimedia form Heriot-Watt University Scotland UK. Her academic interest areas are Information studies, multimedia content, educational technology and media, area of expertise, human- computer interaction, usability, computers in education.

**Candra Sumantri** is a n alumni of Department of Physic Education Universitas Negeri Medan, Indonesia. He is concerning on information technology development and now he is Information Technology staff of PT. Global Adhi Pratama one company engaged in the field of services and distribution of IT products, especially in the field of security.

## REFERENCES


Aksoy, G. (2012). The Effects of Animation Technique on the 7th Grade Science and Technology Course. *Creative Education*. June 2012. Vol.3, No.3, 304-308. doi:10.4236/ce.2012.33048.

Al-Aidaroos, A. S. A., & Mutalib, A. A. (2015). Personal digital mutawwif: A multi-modal mobile hajj assistance using the location-based services. *Jurnal Teknologi*. 77(29). 15-20.

Amadieu, F., Marine, C., & Laimay, C. (2011). The attention-guiding effect and cognitive load in the comprehension of animations. *Computers in Human Behavior*. 27(1). 36-40.

Austin, K. A. (2009). Multimedia learning: Cognitive individual differences and display design techniques predict transfer learning with multimedia learning modules. *Computers and Education*. 53(4). 1339-1354.

Aziz, N., Roseli, N. H. M., & Mutalib, A. A. (2011). Visually impaired children's acceptance on assistive courseware. *American Journal of Applied Science*. 8(10). 1019-1026.

Aziz, N., Mutalib, A. A., & Sarif, S. M. (2015). The design principles of assistive courseware for low vision (AC4LV) learners. *ARPN Journal of Engineering and Applied Science*s, 10 (3), pp. 1447-1456.

Aziz, N., Mutalib, A. A., & Sarif, S.M. (2017). User experience of interactive Assistive Courseware for Low Vision learners (AC4LV): Initial round. *TEM Journal*. 6(3). 488-496.

Baharuddin, & Dalle, J. (2017). Interactive courseware for supporting learners competency in practical skills. *Turkish Online Journal of Educational Technology*. 16(3). 87-98.

Baygin, M., Yetis, H., Karakose, M., & Akin, E. (2016). An effect analysis of industry 4.0 to higher education. *The 15th International Conference on Information Technology Based Higher Education and Training*, ITHET. 7760744.

Blackmon, M. H., Polson, P. G., Muneo, K., & Lewis, C. (2002). *Cognitive Walkthrough for the Web*. CHI 2002. 4(1). 463-470.

Butcher, K. R. (2006). *Integrating Visual and Verbal Knowledge During Classroom Learning with Computer Tutors*. (kbutcher@pitt.edu).

Butcher, K. R. (2014). *The multimedia principle in multimedia learning*. In R. E. Mayer (Ed.), The Cambridge handbook of multimedia learning. New York: Cambridge University Press

Carter, D. (2017). Creativity in action – the information professional is poised to exploit the fourth industrial revolution: The business information survey 2017. *Business Information Review*. 34(3). 122-137.

Chiang, T. H. C., Yang, S.-J.-H., & Hwang, G.-J. (2014). An Augmented Reality-based Mobile Learning System to Improve Students' Learning achievements and Motivations in Natural Science Inquiry Activities. *Educational Technology & Society*, 17(4), 352–365.

Chiapetta, & Koballa (2006). S*cience Instruction in the Middle and Secondary Schools: Developing Fundamental Knowledge and Skills for Teaching*, sixth edition, New Jersey: Pearson Education, Inc.

Clark, R. C. (2014). Multimedia Principles in e-Courses. In R. E. Mayer (Ed.), The Cambridge handbook of multimedia learning. New York: Cambridge University Press.

Cooper, A., Reimann, R. Cronin, D., & Noessel, C. (2014). *About Face: The Essentials of Interaction Design*, 4th Ed. Wiley.

Dolhalit, M. L., Salam, S. N. A., Mutalib, A. A., &Yusoff, M. S. B. (2017). Towards the development of Persuasive Multimedia Model of Truancy Awareness (PMTA): *Review of research. Journal of Engineering and Applied Sciences.* 12(16). 4215- 4221

Doyan, A., & Sukmantara, I. K. Y. (2014). The Development of Physics Intranet Web to Improve the Concept Comprehension and Problem Solving Skills of the Students of SMK. *Jurnal Pendidikan Fisika Indonesia* 10 (2), 117-127. doi: 10.15294/jpfi.v10i2.3348.

Elkabani, I., & Zantout, R. (2015). A framework for helping the visually impaired learn and practice math. 2015 5th I*nternational Conference on Information and Communication Technology and Accessibility*, ICTA 2015

Fautch, J. M. (2015). The Flipped classroom for teaching organic chemistry in small classes: Is it effective? *Chemistry Education Research and Practice*, 16(1), 179-186. doi:10.1039/c4rp00230j.

Gardner, H. (1983). Frames of Mind. New York: Basic Book Inc.

Gardner, H. (1993). Multiple Intelligences: The Theory in Practice, NY. Basic book

Karajeh, W., Hamtini, T., & Hamdi, M. (2016). Designing and implementing an effective Courseware for the Enhancement of e-learning. *International Journal of Emerging Technologies in Learning*. 11(4). 70-76.

Li, G., Hou, Y., & Wu, A. (2017). Fourth Industrial Revolution: technological drivers, impacts and coping methods. *Chinese Geographical Science*. 24(7). 626-637.

Mautone, P. D., & Mayer, R. E. (2001). Signaling as a cognitive guide in multimedia learning. *Journal of Educational Psychology*. 93. 377-389.

Mayer, R. E., & DaPra, C. S. (2012). An embodiment effect in computer-based learning with animated pedagogical agent. *Journal of Experimental Psychology: Applied*, 18, 239-252.

Mayer, R. E., Heiser, H., & Lonn, S. (2001). Cognitive constraints on multimedia learning: When presenting more material results in less understanding. Journal of Educational Psychology, 93, 187-198.

Mayer, R. E. (2017). Using multimedia for e-learning. *Journal of Computer Assisted Learning*. 33(5). 403-423.

Mayer, R. E. (2009). *Multimedia learning* (2nd ed). New York: Cambridge University Press. Mayer, R. E. (2011). Applying the science of learning. Upper Saddle River, NJ: Pearson.

Mayer, R. E. (2014). *Principles based on social cues: Personalization, voice, image, and embodiment principles.* In R. E. Mayer (Ed.), The Cambridge handbook of multimedia learning. New York: Cambridge University Press.

Mayer, R. E., & Fiorella, L. (2014). *Principles for reducing extraneous processing in multimedia learning: Coherence, signaling, redundancy, spatial contiguity, and temporal contiguity principles*. In R. E. Mayer (Ed.), The Cambridge handbook of multimedia learning. New York: Cambridge University Press.

Mayhew, D. J. (1999). *The Usability Engineering Lifecycle*. Morgan Kaufmann, San Francisco

Mohd, C. K. N. C. K., & Shahbodin, F. (2016). Design and development of a multimedia courseware using personalized learning environment approach for nutrition topic. *ARPN Journal of Engineering and Applied Sciences*. 11(18). 10714-10720.

Munadi, Y. (2008). *Learning Media - A New Approach*. Jakarta: Gaung Persada Press.

Nielsen, J. (1994). *Usability Engineering*. Morgan Kaufmann Publishers Inc.

Preece, J., Sharp, H., & Rogers, Y. (2015). *Interaction Design: Beyond Human-Compter Interaction* 4th Ed. Wiley.

Schneiderman, B., Plaisant, C., Cohen, M., Jacobs, S., Elmqvist, N., & Diakopoulos, N. (2016). *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, 6th Ed. University of Maryland.

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. New York: Springer

Stankova, E. N., Barmasov, A. V.. Dyachenko, N. V.. Bukina, M. N., Barmasova, A. M., & Yakovleva, T. Y. (2016). *The use of computer technology as a way to increase efficiency of teaching physics and other natural sciences.Lecture Notes in Computer Science* (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). 9789, 581-594.

Toenders, F. G. C., De Putter-Smits, L. G. A., Sanders, W. T. M., & Den Brok, P. (2017). Improving physics teaching materials on sound for visually impaired students in high school. *Physics Education*. 52(5)

Tomita, K. (2017). Does the Visual Appeal of Instructional Media Affect Learners' *Motivation Toward Learning? TechTrends*. 1-10.

Tosho, A., Mutalib, A. A., & Abdul-Salam, S. N. (2016). Conceptual design model of instructional interfaces: Courseware for inclusive education system (IID4C) distance learning. *International Journal of Distance Education Technologies*, 14 (4), pp. 68-82.

Ward, J. (2016). Are you ready for the fourth industrial revolution? Australian Mining.108(11). 36-37.

Walsh, T., Petrie, H., & Odutola, O. (2014). Developing interactive systems for different cultures: Issues of assessing user experience with visual materials. *Proceedings of the 26th Australian Computer-Human Interaction Conference*, OzCHI 2014, pp. 470-479.

# 13. Development of Guide InquiryBased Learning Devices to ImproveSudent Leaning Outcomes in Science Materials in Middle School

Ade Budhi Rahayu, Sutarto Hadi, Maya Istyadji, Muhammad Zaini, Arif Sholahuddin, Fahmi

Lambung Mangkurat University, Banjarmasin, Indonesia

**ABSTRACT**

The quality of education in Indonesia is still low based on data from international studies, namely the education development index shows that Indonesia has not moved from the medium or medium category, especially in the field of science. This fact assumes science learning as a problematic learning content. This study aims to develop a learning device that is able to overcome these problems on a local scale. This study uses the Design of Educational Research and its development model uses the Dick and Carey approach. The subjects used in the one-to-one test amounted to 3 people, the small group test amounted to 14 people, and the test of a large group of 60 class VII SMP students with a testing area in Banjarbaru. Learning outcomes show improvement in both the experiment and the control class with an increase category at the moderate level. Data shows normal distribution and both classes are considered homogeneous and the t-test shows that there is a significant influence between the use of guided inquiry models compared to conventional learning using developed tools.

Keywords: development of learning tools, guided inquiry, student learning outcomes

## 1. INTRODUCTION

The learning system in Indonesia currently adheres to the 2013 curriculum that prepares students who are competitive, productive, creative, innovative, and affective who are good and contribute to society. The purpose of

learning is to obtain behavioral learning outcomes that are expected. Slavin (2000) defines learning goals as the direction to be addressed from a series of activities carried out in the learning process. In integrated science learning, the learning objectives to be achieved are so that students can experience the whole learning process, understand natural phenomena through problem solving activities, scientific methods, and imitate the way scientists work in finding new facts (Ministry of National Education, 2010). These learning experiences are the aim of training students' science process skills (Nadziroh et al., 2018).

But the quality of education in Indonesia is still low, this can be seen from the data from international studies, the education development index for all or education for all, Indonesia has not moved from the medium or medium category. Based on the report of the United Nations Education, Science and Culture Organization (UNESCO) in 2012, Indonesia ranked 64th out of 120 countries after previously in 2011, Indonesia was ranked 69th out of 127 countries. As for the education rankings of the ASEAN region in 2017, Indonesia is ranked 5 with a score of 0.603 while Singapore is ranked 1, Brunei Darussalam 2, Malaysia 3 and Thailand is ranked 4 (DW, 2017). Likewise the results of data from Puspendik Balitbang Kemdikbud state that the results of the National Final Examination (UAN) for 2013/2014 Academic Year at the junior high school level for Banjarbaru City are ranked 10th out of 13 districts/cities in South Kalimantan province. The results of this data show that education in the city of Banjarbaru still needs to be improved both at the provincial level and at the national level. Whereas for the average science score of 7.03. This fact, shows that in general students view science lessons as an uninteresting and unpleasant lesson. The event was caused by the learning carried out in school or class was still not in accordance with the nature of science learning (Ali et al., 2013).

Learning will be more meaningful if students are given the opportunity to know and be actively involved in finding concepts from existing phenomena from the environment with the guidance of teachers (Fahmi and Irhasyuarna, 2017). If science learning is not taught according to the nature of science learning, learning outcomes will not be optimal (Johari, 2014). Learning is the process of interaction between students and teachers and learning resources in a learning environment, so to realize the goals of science learning in schools, science teachers should understand the nature of science, be able to become facilitators of learning in accordance with the abilities and needs of students as designed in the curriculum (Ali et al., 2013).

The nature of science learning has three components, namely the product component, process and attitude. Science as a product means a set of facts, concepts, principles and laws about natural phenomena. Science as a process is a series of structural and systematic tests carried out to find concepts, principles, laws and natural phenomena. While science as an attitude is expected to be able to shape character. So that it is clear that what is desired in science learning is that students are able to behave and be able to show their character (Suastra, 2009). One of the learning models in order to achieve these objectives is guided inquiry learning. Because in the guiding principle of implementing the curriculum in learning is to use a contextual approach to the strengthening process using a scientific (scientific) approach and authentic assessment that uses the principle of assessment part of learning. The scientific approach to learning can be applied using the Discovery/Inquiry learning model (Permendikbud Number 58 of 2014 concerning Standard and Middle Education Process Standards). The use of guided inquiry is due to the intellectual development of students at middle school age according to Piaget at the formal operational level. That is, in this period children have been able to think logically, think with formal theoretical thinking based on propositions and hypothesize. To achieve these objectives the role of the teacher is needed in learning (Rizal, 2014).

Guided inquiry learning is considered appropriate to be used for seventh grade students of SMP, because the characteristics of class VII junior high school students who are still not fully able to learn self-directed, the level of cognitive development of students in the intermediate stage from concrete operations to formal operations. Still needing the teacher as a guide so students are able to reflect on the learning experience. Guided inquiry is a learning activity that places the teacher to determine the topic and motivates students to arise questions in the minds of students then students are tasked with formulating hypothetical problems, working procedures, analyzing data and concluding it but still under teacher guidance.

According to Towndrow and Ling (2008), inquiry is learning that does not only use methods of remembering facts but must also include planting the application of knowledge to students. The advantages of guided inquiry learning methods are: (1) Encouraging students to think and formulate their own hypotheses, (2) Encourage students to think and work on their own initiative, (3) Teaching becomes more student- centered, (4) Students can form and

develop concepts own. So inquiry really supports the theory of constructivism in its implications (Roestiyah, 2001). The research results of Rahmawati (2012) concluded that learning using guided inquiry methods can improve learning abilities, namely by making students more active in the learning process so that they can also increase student activity in thinking, so as to improve student learning outcomes.

Learning outcomes are a series of mental body activities to obtain a change in behavior as a result of the experience of individuals interacting with their environment concerning cognitive, affective and prikomotor. The learning outcomes in the form of affective and psychomotor one of which is the ability of science process skills of students (Djamarah, 2002).

Improving the scientific performance of students through learning activities that are able to improve their process skills and scientific attitudes, which will later lead to the creation of long-term concepts in the memory of students (Fahmi and Irhasyuarna, 2017). Students with high scientific performance will certainly be able to shape their own knowledge. This is in line with the principle of constructivism, that students are actively constructing their knowledge. So, the teacher does not need to worry about lack of time to complete the material that is the demand of the curriculum, because with the scientific performance that is owned, students are able to build their own knowledge, which will lead to improving student learning outcomes (Setiadi and Irhasyuarna, 2017). Learning is not only limited to the place and fixated on the teacher in the school, because with the increase in scientific performance, students can explore knowledge anywhere.

Science subjects in junior high school are one of integrated learning. Integrated learning is learning that begins with a particular subject or theme that is related to another subject, certain concepts are associated with other concepts, which are applied spontaneously or planned, either in one field of study or more, with a variety of children's learning experiences, so that learning become more meaningful. But in the implementation in the field it has not been realized perfectly, where the delivery of material to students is still separately between physical, biological, chemical and IPBA material. The low scientific performance of students reflects the low motivation of students to learn science (Dewi, 2013). There are a number of things that have become difficulties in implementing integrated science in junior high schools, among others: 1) teacher readiness, so far science teachers from disciplinary backgrounds are indeed separate from phys-

ics, biology and chemistry, 2) difficulty integrating science concepts into integrated learning, 3) there are still a few printed textbooks that contain science concepts in an integrated manner. Based on the inhibiting factors in the application of science, try to overcome by making a learning tool that can train students' process skills and improve learning outcomes and apply them in the field. These results will be seen how much the success of Integrated Science learning with a contextual approach to the strengthening process using a scientific (scientific) approach and authentic assessment that uses the principle of evaluating part of learning requires an innovative planning, implementation and assessment.

In the process, the steps taken when developing the device are: a) identifying learning objectives, b) conducting in-depth learning analysis, c) identifying student characteristics, d) formulating specific learning objectives, e) developing test items, f) developing strategies learning, g) developing and selecting learning tools, h) designing and implementing formative evaluations, and i) revising learning. All development steps are based on the Dick and Carey model approach so that the process runs systematic and hierarchical in order to achieve the research objectives. Considerations in choosing the Dick and Carey models, (1) Dick and Carey's theoretical basis are goal- oriented, condition variables, and results are used to establish optimal learning methods (Reigulut, 1983), (2) can be used to design learning materials, both for the need to study both classical and individual classes, (3) can be used to develop learning materials in the intellectual realm, attitudes, skills, and verbal information, and (4) the Dick and Carey models show a very clear, concise, unbroken relationship between step one step with the other.

## II. METHODS

This study uses the Design of Educational Research. This study resulted in the form of a learning tool and the results of its application in the classroom using a guided inquiry based learning model. Learning tools to be developed in this study are Syllabus, lesson plans, teaching materials, LKPD, and learning outcomes tests where the research instruments are in the form of assessment instruments (lesson plans, teaching materials, LKPD, readability of teaching materials and LKPD, assessment sheet validation instruments, observation sheet instruments) (implementation of teacher and student activities), learning outcomes test instruments, science process skills, character attitude assessment instruments, social attitude assessment instruments, psycho-

motor skills assessment instruments. The development model uses the Dick and Carey Model approach. Subjects used in the one test -to-one numbered 3 people, a small group test of 14 people, and a large group of 60 people from Class VII of a junior high school in Banjarbaru.

## III. RESULTS AND DISCUSSION

The device was made to adjust the 2013 curriculum and continued to be revised to adjust needs in the classroom. Its development is assessed by validators and observations that are considered experts in their fields. Based on the results of the validation test that has fulfilled the valid elements used in the learning together with a one-to-one trial and a draft II device. Draft device II was applied in small groups and analyzed the progress of learning through teacher activities and student activities. Teachers are considered capable of managing learning well using the developed tools. The same is true for students who are considered good when applied to devices developed by researchers. This condition illustrates the effectiveness of expectations achieved. The device was revised to draft III devices before becoming the final device.

In the field test assessed the progress of students towards the application of learning devices. First, learning outcomes during learning are assessed in Table 1.

| Class | Score Pretest | Completeness | Score Postest | Completeness | Gain | N=gain | Increase Category |
|---|---|---|---|---|---|---|---|
| Experiment | 68.67 | 46.67% | 83.17 | 90.00% | 14.50 | 0.51 | Moderate |
| Control | 64.40 | 30.00% | 76.03 | 70.00% | 11.63 | 0.34 | Moderate |
| **Category:** High G = g value ≥0,70, Medium G = g value 0,30 ≤ g ≥ 0,70, Low G = g value ≤ 0,30 | | | | | | | |

Table 1: Field Test Data

The average difference test is used to determine the differences in cognitive learning outcomes of experimental class students taught by guided inquiry methods and control classes taught by conventional methods. The different test steps for the two samples (two sample t-test) are as follows.

3.1 Normality Test

The data normality test aims to find out whether the data comes from the normal distribution population. To test normality is to use the help of SPSS version 22.00 software with · = 5% and the results can be seen in Table 2 below.

| | Kolmogorov-Smirnov[a] | | |
|---|---|---|---|
| | Statistic | df | Sig. |
| Experiment | 0.106 | 30 | 0.200 |
| Control | 0.102 | 30 | 0.200 |
| a. Lilliefors Significance Correction | | | |

Table 2: Normality Test of Post-Test Data of Experimental Class and Control Class

Based on the table above, it is known that the results of the posttest normative data of the experimental class obtained a significant value of 0.200 while the control class was 0.200. That is, the significance value of the experimental and control class data is more than 5%, which means that the experimental class and control post-test data are normally distributed.

3.2 Homogeneity Test (Variant Similarity Test)

The homogeneity test was carried out to obtain the assumption that the study sample originated from a homogeneous condition. To test homogeneity is to use SPSS software version 22.00 with · = 5% and the results can be seen in table 3 below.

| Levene's Test for Equality of Variances | |
|---|---|
| F | Sig. |
| 1.068 | 0.306 |

Table 3: Homogeneity Test Results

Based on the table above, there is a significant level of 0.306 or more than 5%, which means there is no difference in data variance between classes using a guided inquiry model with conventional learning, meaning both classes are homogeneous.

3.2 Independent Sample t-Test

Testing the difference in the average test of mathematical communication skills between students with guided inquiry model learning and control class with conventional learning is done to determine whether the use of a guided inquiry model will produce better values or not.

Hypothesis:

$H_0$: μ1 d" μ2 (class average value using a guided inquiry model less than or equal to the class average value with conventional learning)

$H_1$: μ1> μ2 (the average value of class learning outcomes using the guided inquiry model model is more than the class average value with conventional learning)

Average difference test, calculated by t test. The results of t-test calculations can be presented in Table 4 below.

| Class | N | Mean | t value |
|---|---|---|---|
| Experiment | 30 | 83,16 | 2,988 |
| Control | 30 | 76,03 | |

Table 4: The Calculation Results Independent Sample t-Test

Based on Table 4 above, it can be seen that the value of t count is obtained at 2.988. The value of t table for db = (n1 + n2-2) = (30 + 30 - 2) = 58 with a significance level of 5% is known as 2,002. Because the value of t count = 2.988> t table = 2.002, it was decided to reject $H_0$ and accept $H_1$. That is, the average value in the class treated with the guided inquiry model is greater than the class average value with conventional learning. This indicates that there is a significant influence between the use of inquiry and conventional learning models on the application of learning devices.

Bilgin (2009) concluded that the results were significantly better in understanding the science concept for the experimental class using a guided inquiry model than in the control class with traditional learning. Some other studies also state the same, among others, according to Berry & Berry (2014) learning using inquiry models can increase engagement and produce meaningful learning, according to Martin & Hansen (2002) the use of guided inquiry in the investigation process requires guidance from the teacher to solve problems. This finding was supported by Dewi, et al. (2013) which states through a guided inquiry model that students are guided to know knowledge through direct experience.

During the learning process also observed and assessed character skills in students. Natural Science Learning (IPA) cannot be separated from character development. The Law of the Republic of Indonesia number 20 of 2003 concerning the National Education System is the basis for the integration of character education into teaching materials as a support for learning facilities. In order for these characters to be manifested in a person, habituation in daily life is needed, both through home education and school education, which is called character education. In simple character education is everything we do intentionally that affects the character of the children we teach.

The principle used in the development of cultural education and national character must be in accordance with what was stated by MONE (2010), namely sustainable, through all subjects, values are developed, and carried out

actively and pleasantly. So with this principle, students can learn through the process of thinking, behaving, and acting. In this study character behaviors that are integrated in learning devices have 4 indicators, namely (1) sense of gratitude, (2) honesty, (3) responsibility, and (4) discipline. In testing the effectiveness of the device and to find out whether or not the revision of the learning device developed character traits in the small group test is also a measure in the assessment, based on the observation table of character behavior in the small group test, for indicators of sense, honesty, responsibility and discipline at 4 face-to-face meetings shows an average of 98% with very good categories. Thus it can be concluded that the learning device developed with the guided inquiry model has been able to bring up the character traits of students with characteristic behavioral attitudes that can be observed, namely in the behavior of gratitude, honesty, responsibility and discipline.

Whereas based on the characteristic behavior observation table in field trial 1, indicators of sense, honesty, responsibility, and discipline at 4 face-to-face meetings showed an average of 95% with a very good category. Thus it can be concluded that the learning device developed with the guided inquiry model has been able to bring up the character traits of students with characteristic behavioral attitudes that can be observed, namely in the behavior of gratitude, honesty, responsibility and discipline. Character behavior in the field test for indicators of sense of sincerity, honesty, responsibility, and discipline in 4 face-to-face meetings with very good categories. Thus it can be concluded that the learning device developed with the guided inquiry model has been able to bring up the character traits of students with characteristic behavioral attitudes that can be observed, namely gratitude, honesty, responsibility and discipline.

## IV. CONCLUSION

This study aims to produce learning devices and their implementation towards guided inquiry based learning models. The observation results of the teacher's ability in learning activities developed during learning using the developed tools show the achievement of each step of the learning activity. The results of the observation of the teacher's activity showed that the implementation of the lesson plan in the field test was 96.6% where each face to face had a reliability of more than 75%, so the device could be categorized as good. From these results it can be concluded that the device is developed practically,

and can be used well by researchers and other teachers. Validators assess the device to meet validity to use. Improvement in cognitive skills is at a moderate level for the experimental and control classes. Whereas in the different test, there is a significant influence on the use of guided inquiry learning models when implemented learning devices developed.

## REFERENCES


Ali, L.U., Suastra, W.I., Sudiatmika, A.A.I.A.R. 2013. Pengelola Pembelajaran IPA Ditinjau dari Hakikat Sains pada SMP di Kabupaten Lombok Timur. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi IPA*, Vol. 3 No. 1.

Bery, M.H. and Berry, G. 2014. Reading an Object: Developing Effective Scientific Inquiry Using Student Questions. *European Journal of Science and Mathematics Education,* Vol.2 No.2, pp. 87-97.

Bilgin, I. 2009. The Effect of Guided Inquiry Instruction Incorporating a Cooperative Learning Approach on University Students' Achievement of Acid and Bases Concepts and Attitude toward Guided Inquiry Instruction. *Scientific Research and Essay*, Vol.4 No.10, pp. 1038-1046.

Dewi, K., Sadia, W., Ristiati, N. P. 2013. Pengembangan Perangkat Pembelajaran IPA Terpadu dengan Setting Inkuiri Terbimbing untuk Meningkatkan PemahamanKonsep dan Kinerja Ilmiah Siswa. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi IPA*, Vol. 3 No. 1.

Dick, W. and Carey, L. 2009. *The Systematic Design of Instruction* Seventh Edition. Pearson Education. New Jersey.

Djamarah, S.B. 2002. *Psikologi Belajar*. Rineka Cipta. Jakarta.

DW. 2017. *Rangking Pendidikan Negara-negara ASEAN*.https: www.dw.com/id/rangking-pendidikan-negara-negara-asean/g-37594464. (accessed on August 1, 2018).

Fahmi and Irhasyuarna, Y. 2017. Misconceptions of Reaction Rates on High School Level in Banjarmasin. *IOSR Journal of Research & Method in Education* (IOSR- JRME). e-ISSN: 2320 – 7388, Volume 7, Issue 1, Ver. IV, (Jan – Feb 2017), PP 54 –61, DOI: 10.9790/7388-0701045461. www.iosrjournals.org

Fahmi and Irhasyuarna, Y. 2017. The Misconceptions of Senior High School Student in Banjarmasin on Chemical Bonding. *Journal of Education and Practice*. Vol. 8, No. 17, pp. 32-39. www.iiste.org

Kemendiknas. 2010. *Bahan Pelatihan: Penguatan Metodologi Pembelajaran Berdasarkan Nilai-nilai Budaya Untuk Membentuk Daya Saing dan Karakter Bangsa*. Kemendiknas RI. Jakarta.

Marjan, J., Arnyana, I.B.P., Setiawan, I.G.A.N. 2014. Pengaruh Pembelajaran Pendekatan Saintifik Terhadap Hasil Belajar Biologi dan Keterampilan Proses Sains Siswa MA. Mu allimat NW Pancor Selong Kabupaten Lombok Timur Nusa Tenggara Barat. *e-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi IPA*, Vol. 4 No. 1.

Martin, L. and Hansen. 2002. Defining Inquiry: Exploring The Many Types of Inquiry in The Science *Classroom. Science Teacher*, Vol.69 No.2, pp. 34-37.

Nadziroh, A., Setiadi, I., Fahmi. 2018. The Effect of Inquiry Model On Science Process Skills and Learning Outcomes. *European Journal of Education Studies*. ISSN: 2501 - 1111. ISSN-L: 2501 - 1111. Vol. 4. Issue. 12. pp. 177-182. doi: 10.5281/zenodo.1344846. www.oapub.org/edu

Permendiknas Nomor 59 Tahun 2014 tentang Tujuan Kurikulum 2013. Depdiknas. Jakarta.

Puspendik. 2014. Laporan Hasil Ujian Nasional SMP/MTs Sederajat Tahun Ajaran 2013/2014. Balitbang Kemendikbud. Jakarta.

Rahmawati, U., Kusuma, E., Cahyono, E. 2012. Pembelajaran Buffer Menggunakan Metode Inkuiri Terbimbing untuk Meningkatkan Hasil Belajar dan Keaktifan. (Online), (http://journal.unnes.ac.id/sju/index.php/chemined/article/view/985. *Chemistry in Education*, Vol. 1 No. 2, pp. 136-141.

Reigulut, C.M. 1983. *Instructional Design Theories and Model: An Overview of Their Current Status*. Hilldate, N.J: Lawrence Erlbaum Associates.

Rizal, M. 2014. Pengaruh Pembelajaran Inkuiri Terbimbing Dengan Multirepresentasi Terhadap Ketrampilan Proses Sains Dan Penguasaan Konsep IPA Siswa SMP. J*urnal Pendidikan Sain*s: ISSN 2338-9117. Vol. 2 No.3, pp. 150- 158.

Roestiyah, N.K. 1991. *Strategi Belajar Mengajar*. Rineka Cipta. Jakarta.

Setiadi, I. and Irhasyuarna, Y. 2017. Improvement of Model Student Learning Through the Content of Solutions Guided Discovery Buffer. *IOSR Journal of Research & Method in Education* (IOSR-JRME), Volume 7 (1) pp. 1-9.

Slavin, R., E. 2011. *Psikologi Pendidikan Teori dan Praktek*. Indeks. Jakarta.

Suastra, I.W. 2009. Pembelajaran Sains Terkini: *Mendekatkan Siswa dengan Lingkungan Alamiah dan Sosial Budayany*a. Singaraja: Universitas Pendidikan Ganesha.

Towndrow, P.A., Ling, T.A., Venthan, A.M. 2008. Promoting Inquiry through Science Reflective Journal Writing. *Eurasia Journal of Technology Education,* Namyang Technological University Singapore, Vol. 4 No. 3: 279-283.

UNESCO. 2012. EFA Global Monitoring Report. http://unesdoc.unesco.org/images/0021/002185/218569E.pdf. (accessed on August 1, 2018).

UNESCO. 2012. *The Education for All Development Index*. https://es.unesco.org/gem-report/sites/gem-report/files/Index_Tables_2011.pdf. (accessed on August 1, 2018).

# 14. The Prospective Innovator in Public University by Scrutinizing Particular Personality Traits

Ersis Warmansyah Abbas, Sutarto Hadi, Ismi Rajiani
Lambung Mangkurat University, Banjarmasin

**ABSTRACT**

The administrative process innovation was adopted with enthusiasm by the Western advanced industrialized countries and was taken for granted as a superior approach that should be practiced. However, public organizations in Indonesia are structured and run differently making public sector employees may have different views toward new ways of doing the job. This article aims to reveal who innovates in the organization by analyzing typical personality traits. The hypotheses are tested through a sample of 200 employees of public universities located in South Kalimantan, Indonesia, and structural equation modeling is used. Applying Hogan Personality Inventory (HPI), the five-factor personality in this research is labeled as adjustment (neuroticism), sociability (extraversion), likeability (agreeableness), prudence (conscientiousness), and school success (openness to experience). The results are discussed regarding the implications for what one can learn from individual-level studies of personality and innovation. Suggestions are offered to those universities interested in encouraging service quality in the public sector via innovation.

Keywords: five-factor personality, innovation, public sector, Indonesia

## I. INTRODUCTION

In Southeast Asia, scholars have become gradually interested in examining innovation in the public sector due to current expectation and demands from the stakeholders (Ab Rahman et al., 2018). One should make clear distinction that if innovation in the business sector aims at improving business

performance (Mol and Birkinshaw, 2014), then in public sector, innovation aims at improving the quality of public services (Mulgan, 2014) as well as to harnessing the problem-solving capacity of governmental organizations in coping with societal challenges (De Vries et al., 2016). Commonly, public sector innovation is associated with reform movements like New Public Management (NPM) (Pollitt and Bouckaert 2017) and electronic government (Homburg, 2018).

In the Indonesian context, the urgency of innovation in the public sector has commenced being a concern since the shift of government system from centralization to decentralization. Until 2001, the Indonesian business processes was still fully manual, slow, costly, and vulnerable to leakage. Several laws were imposed as the normative basis for local governments to innovate in administering governance in region and since then some provinces in Indonesia has become the best practice references in implementing innovation in public service for having institutional innovation through capacity building and the mindset changing from bureaucratic to entrepreneur mindset as requested by New Public Management initiatives (Common, 2017). However, the results of previous research (Darono and Irawati, 2015) indicated that Indonesian public sector apparatus prefer to work conventionally instead of operating technology information-based.

The literature reviews on public innovation conductedin recent years aim to conceptually, rather than empirically on the basis of explicitdata such as in case studies and surveys, grasp the meaning and importance of public sectorinnovation (De Vries et al., 2016) including the one from Indonesia (for instance, Ahmad, 2018). Other researchers in Indonesia address this challenge through an interpretive research paradigm (for example, Darono and Irawati, 2015). This phenomenon can become a vital shortcoming as systematic overviews of empirical evidence areessential to conclude the existing, evidence-based body of knowledge and to establish a future research direction on a newly emerging trend of public innovation.

In the globalization era, to swim with the current trend, the public sector must have aninnovation imperative in which being successfulin innovation is compulsory for national growth and survival. It occurs at an individual, business, andnational level and has risks and challenges at each level. A crucial focus for research, then, concerns the drivers of innova-

tion. Which factors are associated with high and low innovation performance? Since public service motivation is strongly influenced by core personality traits (Van Witteloostuijn et al., 2016), and in the process of innovation, specific knowledge in an individual becomes a vital constituent (Urbancova, 2013), we empirically test the relationship between personalityand innovation reflected in the achievement of innovation outcome of the public sector.

## II. LITERATURE REVIEW

This chapter, a literature review (the theoretical bases), presents the research results related to the big five personality traits and innovation in the public sector environment.

*The Five-Factor Model*

Though considerable work has been invested in identifying which traits characterize an individual's personality and thereby make him or her different from other people (Judge and Zapata, 2015; Sutin et al., 2016; Mõttus et al., 2017; Sleep et al., 2018, Cristea, 2017), personality psychologists finally have agreed to five personality constructs called as the Big Five are sufficient to describe the fundamental dimensions of normal personality (Oshio et al., 2018). McCrae and Sutin (2018) have reassured that the five-factor personality is not inventions of western psychologists; they are part of human nature of general dispositions that somehow find expression in every culture.

The Five-Factor Model states that all personality traits can be summarized into five main factors: Neuroticism, Extraversion, and Openness to Experience, Agreeableness, and Conscientiousness (McCrae, 2015). Neuroticism includes the traits that represent characteristics such as vulnerability to stress, emotional lability, and a tendency toward negative mood states. Extraversion specifies the level of external versus internal orientation. It covers elements such as confidence, passion, positive emotionality, and willingness to involve with the sociophysical environment. Openness to Experience describes one's desire to engage in, or with, novel experiences and ideas. Opennessincludes any category of new knowledge, including the appreciation of modern art, acceptance of alternative value systems, and the desire to listen to challenging philosophies and worldviews. Agreeableness is more or less as the label implies. Persons who scored high on this would be described as *trustworthy, honest, compliant,* and *modest.* It measures the manner in which one con-

ducts his or her social relationships. Finally, Conscientiousness captures such aspects as one's sense of duty, desire to achieve, willingness to complete tasks to a high standard, and self-discipline (Steel et al., 2012). Hogan (2005) developed self-report inventory to measure Big Five factor where the dimension of the Big Five is labeled as Adjustment (Emotional Stability), Sociability (Extraversion), Likeability (Agreeableness), Prudence (Conscientiousness) and School Success (Openness to Experience). Adjustment, sociability, and prudence are positively related with individualism (Hofstede and McCrae, 2004), while as a collectivist society, Indonesian is scored low on these dimensions. In this context, these variables are excluded from the model.

*Management Innovation*

Although beginning to attract academic interest, management innovation remains an under-researched topic (Nieves and Ciprés, 2015). Scholars have started emphasizing that, to be optimal, technological innovation needs to be combined with management innovation (Damanpour and Aravind, 2012). If technological innovation is concerned with the introduction of changes in technology relating to an organization's primary activity, management innovation reflects changes in the way management work is done, involving a departure from traditional processes (i.e., what managers do as part of their jobs); in practices (i.e., the routines that turn ideas into actionable tools); in structure (i.e., the way in which responsibility is allocated); and in techniques (i.e., the procedures used to accomplish a specific task or goal). About this, Mol and Birkinshaw (2014) propose that management innovation tends to emerge through necessity, as opposed to technological innovations that may first be developed in a laboratory and for which an application may subsequently be found.

Mol (2018) define management innovation as the generation and implementation of new management practice, process, structure, or technique that is recent to state of the art and is aimed at further organizational goals. Innovation in the public sector is defined as the creation and implementation of new processes, products, services, and methods of delivery that will create improvements in the efficiency, effectiveness or quality of outcomes (Mulgan, 2014). In this context, innovation in public sector resembles management innovation where the difference is only in the place of practice where management innovation occurs in the business setting while the later is the government agencies. In the public sector, innovation can be triggered by several factors such as the shift in government policies, stakeholder push, technologi-

cal adoption, or individuals awareness toward something new to improve the way they work (Darono and Irawati, 2015). Observing the current literature on public sector innovation (e.g., De Vries et al., 2016; Pollitt and Bouckaert, 2017; Man and R▪ va , 2017), we conclude that the documentaries depend heavily on intra-organizational process innovations, which are strictly connected to two significant changing flux in public administration, namely NPM and e-government. Further, the objectives of public sector innovation are not only increasing effectiveness and efficiency (Kim et al., 2009), tackling societal problems, improving customer satisfaction (Turner et al., 2011), as well as involving citizens and private partners (Carter and Bélanger, 2005).

## III. DATA AND METHODOLOGY

This research employs quantitative methods to analyze which personality traits of government employees were tending to achieve innovation practices in the public sector. Samples of 200 civil servants were obtained from 2 (two) public universities in Banjarmasin, South Kalimantan Province, Indonesia. This area is chosen as until now it has never received an award from the central government in public service innovation. Common civil service practice, the government bodies in this province recruited predominantly high school and university graduates, who entered the employment hierarchy at basic entry levels. Selection emphasized applicants' educational qualifications and paid little regardless to work experience gained from other organizations. Although some civil service-style personnel practices were reformed, essential counter-productive elements were retained, including seniority-based promotions and lifetime employment. Conditioned this way, the authors applied purposive random sampling by intentionally selected employees in the lowest hierarchy as they performed the service based on the instruction mandated by the law through the reinforcement from immediate supervisors. The purposive sampling technique is a non-probability sampling that is primarily used when one needs to study for sure what needs to be examined and determine who can and are willing to provide the information under knowledge or experience (Oliver and Jupp, 2006).

Path analysis with Partial Least Square was used to test the relationship of personality and innovation. As PLS is well known for the capability of handling small sample sizes and few indicators, a sample numbered 100 to 200 is usually a good starting point in carrying out path modeling (Goodhue et al., 2012).

The data for personality was collected by standard questioners developed by Hogan (2005) and self-adjusted questionnaires to measure the inclination to innovate. Based on the theoretical framework which was detailed in the previous part of the paper, the following research hypotheses were set before the research:

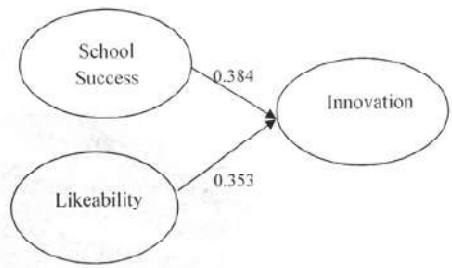
The research hypothesis 1 (H1): *Hypothesis 1: On its established links to be well- educated, school success is positively associated with innovation.*

The research hypothesis 2 (H2): *Likeability is positively associated with innovation since being easy to live with, and sensitivity to others are critical to managing innovation networks.*

## IV. RESULTS

The inner model of this research is shown in Figure 1.

Figure 1. The inner model




The result summary for reflective outer models is presented in Table 1.

Table 1. The result summary for reflective outer models

| Latent Variables | Indicators | Outer Loadings | Average Variance Extraction |
|---|---|---|---|
| School Success | Good memory | 0.813 | 0.792 |
| | Education | 0.767 | |
| | Math ability | 0.788 | |
| | Reading | 0.801 | |
| Likeability | Easy to live with | 0.858 | 0.783 |
| | Sensitive | 0.736 | |
| | Caring | 0.803 | |
| | Likes people | 0.783 | |
| | No hostility | 0.736 | |
| Innovation Output | Increasing effectiveness | 0.680 | 0.745 |
| | Increasing efficiency | 0.791 | |
| | Tackling societal problems | 0.713 | |
| | Improving customer satisfaction | 0.828 | |
| | Involving citizens | 0.716 | |
| | Involving private partners | 0.742 | |

Conventionally, "Cronbach's alpha" is used to measure reliability in social science research but it tends to provide a conservative measurement in PLS-SEM. Prior literature has suggested the use of "Average Variance Extraction (AVE) for convergent validity" as a replacement (Hair et al., 2012). From Table 1, such values are shown to be larger than 0.5 so high levels of convergent reliability have been demonstrated among all three reflective latent variables (Bagozzi et al., 1988; Hair et al., 2012). The score for the path coefficient and p-values in the inner model are shown in Table 2.

Table 2. The result of the path coefficient

| No. | Variables | Path Coefficient | $R^2$ | P-Value | Remark |
|---|---|---|---|---|---|
| 1. | School success→innovation | 0.384 | 0.40 | 0.00 | Significant |
| 2. | Likeability→innovation | 0.353 | 0.36 | 0.00 | Significant |

The result indicates that the school success traits (those with good memory, good education, good at math as well as good at reading) positively affect the implementation of public sector innovation to increase effectiveness, to improve efficiency, to tackle societal problems, to increase customer satisfaction, to involve citizens, and to engage private partners. The path coefficient for this construct is 0.384, and the p-value is 0.00. Similarly, likeability traits (those who are easy to live with, sensitive, caring, like people and no feeling of hostility) positively influence the implementation of public sector innovation to increase effectiveness, to improve efficiency, to tackle societal problems, to increase customer satisfaction, to involve citizens, and to include private partners. The path coefficient for this construct is 0.353, and the p-value is 0.00.

The model goodness of fit is measured with the Stone–Geisser Q-square test for predictive relevance (Chin, 2010) with the formula:

$$Q2 = 1 – (1 – R1^{2}) (1 – R2^{2}) ... (1- Rn^{2})$$

The coefficient of determination ($R^2$) for school success and likeability is 0.40 and 0.36 respectively. Based on these figures, the Q-square predictive relevance is calculated as follows:

$$Q2 = 1 - (1 - R1^{2}) (1 – R2^{2})$$
$$= 1 - (1 – 0.40) (1-0.36)$$
$$= 1 - (0.60) (0.64)$$
$$= 1 – 0.384 = 0.616 (61.6\%)$$

Since Q-squares is greater than 0.5, the model is stable and the predictive relevance requirement is satisfactory.

## V. DISCUSSION

The primary hypothesis in this research was that there is a relationship between personality factors and achieving public sector innovation objective. The multivariate statistical test has provided sufficient support where school success (openness to experience) and likeability (agreeableness) traits proved positive associations with innovation. These findings indicate that at least certain aspects of personality, as measured by the Hogan Personality Index; play an essential role in innovative activity in the public sector. Even though public sector is somewhat different from business sectors regarding the objective of the innovation, the finding of this research is in line with the result that school success and likeability are factors of personality related to innovation (Steel et al., 2012). George and Zhou (2001) assert that employees with high school scoresappreciate for things that are novel and unique due to their higher sensitivity to and range of experience may cause themto show up with innovative solutions to problems and creative ideas to improve on current practices. De Vries et al. (2016) in their review of characteristics of individuals who innovate in public sector listed the factors of employee autonomy (empowerment), organizational position, job-related knowledge and skills, creativity (risk-taking, solving of problems), demographic aspects, commitment/satisfaction with job, shared perspective and norms and innovation acceptance as the most determinant factors. Likeability (agreeableness) relates to getting along with others in comfortable and satisfying interaction (Matzler et al., 2011). Patterson et al. (2009) indicated the significance of cooperation, communication, articulation, and social networking of employees for successful innovations.

The discussion mentioned above implies that employees withschool success and likeability personality will innovate if the situation allows for the manifestation of creativity, eg. being empowered. This way, the duty of line managers is to develop the condition for innovation and creativity (Lichtarski and Trenkner, 2018; Ulewicz and Kuc)  ba, 2016).

The organization has possessed people required in public sector innovation rhetoric yet the progress has remained slow and unconvincing. This way, we examine the status quo by using institutional analysis theory. Holland (2007) observing from a public policy reform point of view, defined institutional analysis as an exploration based on understanding how some rules mediate and distort, sometimes fundamentally, the expected impacts of public policy.The current practice now is that employee performance is run by completing out

evaluation sheet known as *DaftarPenilaianPelaksanaanPekerjaan* (DP3, literally: Work Implementation Evaluation Register). The DP3 approach emphasized intangible employee attributes such as responsibility, loyalty, honesty, cooperativeness, general attitude, and initiative, rather than on output. The DP3 assessment was usually favorable, and there was little differentiation among employees. As a result, nearly all individuals received an automatic salary increase every two years, and an automatic salary grade increases every four years. In circumstances where DP3 focus on 'loyalty' as the principal indicator of 'performance,' employees had little opportunity to improve productivity by being creative and innovative. Those scoring high in school success and likeability, thereby contributed more to company performance might be demotivated by finding the fruits of their labors going disproportionately to 'free riders'. As Van Witteloostuijn et al. (2016) denote that public service motivation is strongly affected by core personality traits - in this case school success and likeability– the spirit of innovation owned by these types of personality is gradually diminished due to a conducive working environment.

The relationship between school success and innovation implies that public sector leaders should encourage people to model different thought as a way to boost the economic growth; civil servants should be willing to consider unconventional or unusual alternatives regardless of their place in the innovation process. Further, the findings concerning likeability suggest that those who deal initially with society in providing services should be informed that their greatest asset when dealing with people is their reputation as an honest person; one whom the community can trust.

## VI. CONCLUSSION

While innovation has been one of the most addressed topics among business practitioner as well as academic discussion, most research has tended to address innovation as the development of new technology, products, and services.Consequently, technological innovation has become a mantra in innovation research. As organizations are confronted with increased competition and a rushingleap of technological change, they need to consider a non- technological innovation that is more challenging to replicate and may give a longer lasting competitive advantage. These non-technological forms of innovations have been referred to management innovation. The success story of the most admired Southeast Asian company Air Asia is an excellent example that owes

its success to management innovation, not technology innovation. Public sector innovation has become a fundamental issue on the agenda of policymakers and academics when discussing the role of government in the era of economy 4.0. Since the government all over the world is currently adopting the model of business practice under the label of New Public management, the public sector is gradually changing the nature of control within organizations by for adapting organizational structures, processes, and practices to generate a valuable source of competitive advantage. In case of the public university in Indonesia, of administrative process innovation remains slow even though the ministry of research and higher education has started to includeinnovation as one of evaluated elements in determining the rank of the university besides human resources, management, research, and students' achievement.

As management innovation both in business and public sector are still relatively under-researched, a better understanding of management innovation or administrative process innovation should be high on the research agenda.Given thatinnovation occurs in a trajectory following a particular path, identifying which individuals will innovate by observing the personality factors is a good starting point of departure.However, a limitation of the current study is the nature of the sample which isdrawn from two public universities making the generalizability of the results toother public services is unknown.

Thus, it is possible that the relationshipsbetween personality dimensions and workplace behavior may varyacross Indonesia. Future researchers could investigate the comparison of the personality traits performing innovation in the public sector in other countries not only in Indonesia or expand into the more heterogeneous sample of respondents.

## REFERENCES

Ab Rahman Z.N., Ismail N., Rajiani I., 2018, *Challenges for managing non-technological innovation: a case from Malaysian public sector*, "Polish Journal of Management Studies", 17.

Ahmad B., 2018, *Service Innovation in Local Government: Analysis of Business Information Services in South Sulawesi Province, Indonesia*, "Mediterranean Journal of Social Sciences", 9(3).

Bagozzi R.P., Yi Y., Nassen K.D., 1998, *Representation of measurement error in marketing variables: Review of approaches and extension to three-facet designs*, "Journal of Econometrics", 89(1-2).

Chin W.W., 2010, *Bootstrap cross-validation indices for PLS path model assessment*, [In:] Handbook of partial least squares, (pp. 83-97), Springer, Berlin, Heidelberg.

Carter L., Bélanger F., 2005, *The utilization of egovernment services: citizen trust, innovation and acceptance factors*, "Information Systems Journal, 15(1).

Common R., 2017, *Public management and policy transfer in South-East Asia*, [In:] Policy transfer in global perspective, (pp. 143-161), Routledge.

Cristea L.A., 2017, *The Share and Evolution of Indirect Taxes in the State's Revenues-Case of Romania*, "Annals of the University of Petro ani – Economics", 17(1).

Darono A., Irawati D., 2015, *Service innovation in the complex environment of tax administration: the Indonesian public sector perspective*, "Interantional Journal of Innovation and Regional Development", 6(1).

Damanpour F., Aravind D., 2012, M*anagerial innovation: Conceptions, processes and antecedents*, "Management and Organization Review", 8(2).

De Vries H., Bekkers V., Tummers L., 2016, *Innovation in the public sector: A systematic review and future research agenda*, "Public Administration", 94(1).

George J.M., Zhou J., 2001, *When openness to experience and conscientiousnessare related to creative behavior: An interactional approach*, "Journal of Applied Psychology", 86.

Goodhue D.L., Lewis W., Thompson R., 2012, *Does PLS have advantages for small sample size or non-normal data?* "Mis Quarterly".

Hair J.F., Sarstedt M., Ringle C.M., Mena J.A., 2012, *An assessment of the use of partial least squares structural equation modeling in marketing research*, "Journal of the Academy of Marketing Science", 40(3).

Hofstede G., McCrae R.R., 2004, *Personality and culture revisited: Linking traits and dimensions of culture*, "Cross-Cultural Research, 38(1).

Hogan R., 2005, *In defense of personality measurement: New wine for old whiners*,"Human Performance", 18(4).

Holland J., 2007, *Tools for institutional, political, and social analysis of policy reform: a sourcebook for development practitioners*, The World Bank.

Homburg V., 2018, ICT, *E-Government and E-Governance: Bits & Bytes for Public Administration*, [In:] The Palgrave Handbook of Public Administration and Management in Europe, (pp. 347-361), Palgrave Macmillan, London.

Judge T.A., Zapata C.P., 2015, *The person-situation debate revisited: Effect of situation strength and trait activation on the validity of the Big Five personality traits in predicting job performance*, "Academy of Management Journal", 58(4).

Kim S., Kim H.J., Lee H., 2009, *An institutional analysis of an e-government system for anti-corruption: The case of OPEN*, "Government Information Quarterly", 26(1).

Lichtarski J., Trenkner M., 2018, *On the Co-existence of Innovation and Creativity in the Lean Management Environment*, "Forum Scientiae Oeconomia", 6(3).

Man M., R▪va B., 2017, *Implications of Lean Manufacturing on Management Accounting in Romanian Organisations*, "Annals of the University of Petro ani – Economics" 17(1) Matzler K., Renzl B., Mooradian T., von Krogh G., Mueller J., 2011, *Personality traits, affective commitment, documentation of knowledge, and knowledge sharing*, "The International Journal of Human Resource Management", 22(02).

McCrae R.R., 2015, *A more nuanced view of reliability: Specificity in the trait hierarchy*, "Personality and Social Psychology Review", 19(2).

McCrae R.R., Sutin A.R., 2018, *A fivefactor theory perspective on causal analysis*, "European Journal of Personality".

Mol M.J., 2018, *Reflections on "the sources of management innovation"*, "Journal of Global Scholars of Marketing Science", 28(3).

Mol M.J., Birkinshaw J., 2014, *The role of external involvement in the creation of management innovations*, "Organization Studies", 35(9).

Mõttus R., Kandler C., Bleidorn W., Riemann R., McCrae R.R., 2017, *Personality traits below facets: The consensual validity, longitudinal stability, heritability, and utility of personality nuances*, "Journal of Personality and Social Psychology", 112(3).

Mulgan G., 2014, *Design in public and social innovation: what works and what could work better,* Retrieved, 23(07), 2015.

Nieves J., Segarra-Ciprés M., 2015, *Management innovation in the hotel industry*, "Tourism Management", 46.

Oliver P., Jupp V., 2006, *Purposive Sampling*, "The SAGE dictionary of social research methods", 245-246.

Oshio A., Taku K., Hirano M., Saeed G., 2018, *Resilience and Big Five personality traits: A meta-analysis*, "Personality and Individual Differences", 127.

Paterson H., Reniers R., Völlm B., 2009, *Personality types and mental health experiences of those who volunteer for helplines*, "British Journal of Guidance & Counselling", 37(4).

Pollitt C., Bouckaert G., 2017, *Public management reform: a comparative analysis-into the age of austerity*, Oxford University Press.

Sleep C.E., Lamkin J., Lynam D.R., Campbell W.K., Miller J.D., 2018, *Personality disorder traits: Testing insight regarding presence of traits, impairment, and desire for change*, "Personality Disorders".

Stee G.D., Rinne T., Fairweather J., 2012, *Personality, nations, and innovation: Relationships between personality traits and national innovation scores*, "Cross- Cultural Research", 46(1).

Sutin A.R., Stephan Y., Luchetti M., Artese A., Oshio A., Terracciano A., 2016, *The five- factor model of personality and physical inactivity: A meta-analysis of 16 samples*, "Journal of Research in Personality", 63.

Turner S., Allen P., Bartlett W., Pérotin V., 2011, *Innovation and the English National Health Service: a qualitative study of the independent sector treatment centre programme*, "Social Science & Medicine", 73(4).

Ulewicz R., Kuc) ba R. 2016, *Identification of problems of implementation of Lean concept in the SME sector*. "Engineering Management in Production and Services", 8(1)

Urbancova H., 2013, *Competitive advantage achievement through innovation and knowledge*, "Journal of Competitiveness", 5(1).

Van Witteloostuijn A., Esteve M., Boyne G., 2016, *Public sector motivation ad fonts: Personality traits as antecedents of the motivation to serve the public interest*, "Journal of Public Administration Research and Theory", 27(1).

# 15. The Managerial Effects of Leaddership, Knowledge Sharing and Innovation in Higher Education

Mohammad Zaenal Ani, Sutarto Hadi, Ismi Rajiani, Ersis Warmansyah Abbas

Lambung Mangkurat University Banjarmasin, Indonesia,

**ABSTRACT**

Fierce competition among academia to pursue the number of publications in a high indexed journal can prevent knowledge sharing in organisations. This article contributes to deepening our understanding of why knowledge sharing occurs and how leaders can enhance this. Scholars have acknowledged leadership as an essential factor in knowledge management and innovation systems across various industries. However, research linking leadership, knowledge sharing, and innovation within higher education, specifically within a newly developed country like Indonesia, is minimal. This research examines the linkages among leadership, knowledge sharing and management innovation, new modes of delivering service, in higher education. The authors surveyed 500 academic staff in Indonesian public universities located in South Kalimantan, Indonesia, and the Structural Equation Modelling result indicated a positive direct effect amongst leadership, knowledge sharing and innovation. Besides, knowledge sharing became a mediator between leadership and innovation, telling that academia in Indonesia is not hiding the knowledge. The result attributed this to the practice of a new model of leadership that nurtures a sense of wholeness, harmony and well-being produced through care, concern and appreciation for both self and others, which is compulsory to the unique group harmony concept among Indonesians.

Keywords: leadership, knowledge sharing, innovation, university.

## I. INTRODUCTION

The growing burden on universities to take a more significant part in national innovation processes and economic development has considerably repositioned the roles of universities all over the world (Gupta, 2020). Consequently, universities are supposed to contribute to the development of exceptionally skilful and conversant workforces and advance knowledge to upkeep the growth of innovative and internationally competitive national economies (Veer-Ramjeawon & Rowley, 2020).

This pattern alteration demanded Higher Education Institutions (HEIs) to create innovative and proper devices, practical approaches and strategies to manage their most vital resource 'knowledge'. This knowledge is meticulously related to Knowledge Management (KM), as universities can adopt it to stimulate economic growth (Stamou, 2017).

To anticipate the trend, the government of Indonesia has adopted several approaches for uplifting university quality, stressing the need to achieve sustainable human development and strengthen the quality of higher education. This strategy comprises many methods like encouraging innovation (Pangarso et al., 2020), knowledge sharing (Arsawan et al., 2020) and displaying proper leaderships to motivate academia on all levels (Gaus et al., 2020; Ahadiat and Dacko-Pikiewicz, 2020). Further, to show the outcome and competitiveness, each lecturer's rank based on some publication and innovative product is updated daily on an official government website. This trend makes competition among lecturers all over the country is very tight. In such condition, the people tend to hide their tacit knowledge for being afraid of losing their power and competitiveness (Hussien & Khedr, 2021).

Most managers want their personnel to share their knowledge spontaneously to work more efficiently and effectively. But, since organisations cannot control the intellectual knowledge of employees, many keep their knowledge to themselves (Connely et al., 2019). Furthermore, a great deal of knowledge management studies inclines to accept a universal approach to knowledge sharing. Yet, attitudes to knowledge sharing are contingent on conditions that diverge across institutional and cultural environments (Arsawan et al., 2020). For example, there is an increasing plea for sharing quality resources and expertise in academic institutions.

However, individual educational institutions prioritise several Scopus and Web of Science indexed publications and the citation displayed on Google Scholar

instead of sharing common visions toward organisational goals. As a result, there is a relatively weak willingness to share knowledge to achieve common academic goals compared to in profit-oriented organisations.

Although knowledge is at the heart of the universities role, knowledge management studies in higher education are still new (Veer-Ramjeawon & Rowley, 2020; Nawaz et al. 2020; Hussien & Khedr, 2021). As a newly developed country, the implementation of knowledge management and management innovation within higher education in Indonesia is still recent, but the chance of acceptance is high (Prasojo, 2020). However, most universities do not display the business-minded approach to innovation that successful practices are not developed further (Rajiani & Ismail, 2019).

Much of the successes of knowledge and innovation processes are associated with leadership styles (Novak et al., 2020). Since knowledge processes are incredibly personal, interactive and empirical (Setini et al., 2020; Ismail et al., 2020), spiritual leadership can contribute to the management of organisational knowledge as it is an instrument for the solidity of person-organisation links.

The relationships between leadership and innovation (Alblooshi et al., 2020), between leadership and knowledge sharing (Hayat Bhatti et al., 2020) and between knowledge sharing and innovation (Arsawan et al., 2020) have become research topics. However, it is necessary to establish any causal relationship between all these constructs as most HEIs duplicate effective knowledge management (KM) initiatives from the private sector without comprehending actual KM concepts and benefits and emphasising merely the usage of IT to adopt. Therefore, this study aims to test whether a structural relationship exists between spiritual leadership and university management innovation through the mediating role of knowledge sharing in Indonesian universities.

## II. LITERATURE REVIEW

Various scholars confirm the impact of leadership styles in innovation processes (Al-Husseini et al., 2019; Tang et al., 2020; Vermeulen et al., 2020). They emphasise consultative and delegative leadership, transformational and transactional leadership, assist in the establishment of innovation for these types of leadership, and provide employees independence to investigate and innovate, contrary to directive leadership styles in which people feel continuously supervised. Spiritual leadership theory (Fry & Nisiewicz, 2020) has arisen as a new genre.

This model emphasises spirituality as a tool for constructing meaning and well-being for employees in the workplace (Yang & Fry, 2018). This way, spiritual leadership suggests creating an inspirational vision that integrates individual and organisational interests, motivates people, and leads to spiritual well-being that converts into higher organisational commitment and productivity (Oh & Wang, 2020). Practically, spiritual leadership encompasses values, attitudes, and behaviours essential to motivate people naturally and create a sense of happiness (Ali et al., 2020). As such, we consider this outlook as relevant to boost innovation.

It combines spiritual needs with work environments conducive to processes management to create, share, and reuse knowledge (Szczepanska-Woszczyna and Kurowska-Pysz, 2016). Karadag et al., 2020). Despite the indisputable prominence of technological innovation, organisations have adopted another type of innovation outside the field of technology (Rajiani & Ismail, 2019).

This non-technological innovation, which is more difficult to imitate and may support a long-lasting competitive advantage, is management innovation (Mol, 2018). Surprisingly, most prominent universities' success story is notable examples that owe their success to management innovation, not technology innovation (Ismail et al., 2020). Mol (2018) defines management innovation as the generation and implementation of new management practice, process, structure, or technique that is new to state of the art and aims to advance organisational objectives.

Spiritual leaders rely on natural inspiration, strict and moral qualities consisted of specific thoughts of hope/faith, vision/mission, and altruistic love are capable of creating employee trust and respect, express confidence in the organisational vision, and accentuate the significance of a shared sense of the organisation's mission (Yang & Fry, 2018). These characteristics motivate subordinates to work hard and innovate. By practising natural inspiration, leaders can encourage followers to reach the performance standard by igniting collaboration and a conducive teamwork climate. They shape the vision, obtain positive commitment to that vision and embolden a suitable condition for innovation (Hunsaker, 2020).

Thus, the authors hypothesise:

H1: Leadership model that develops vision, hope/faith and altruistic love is positively related to management innovation in Indonesian universities.

Knowledge sharing is a strategy where one individual gives information to another in the form of work data, skill to assist colleagues to advance coordinated

effort, critical thinking, advancement of groundbreaking thoughts and execution techniques (Arsawan et al., 2020). Despite the organisational advantages of knowledge sharing, employees are often reluctant to share their insight, as it transforms their valuable knowledge into public consumption (Bhatti et al., 2020).

Researchers have lately investigated leadership as a device to deliver this encounter and to expedite knowledge sharing in organisations. The current literature has given early indication that distinctive leadership styles can enable knowledge sharing (Archanjo de Souza et al., 2020). However, the systems through which leaders influence knowledge sharing at an individual level remain less investigated (Bhatti et al., 2020). Spiritual leaders will, in general, stress the significance of the collective sense of the organisation's mission (Fry et al., 2017), which is following the human resources management practice in a collectivist nation (Rajiani and Kot, 2020). When individuals feel that their chiefs believe in them and like their endeavours, they will be more able to offer thoughts and share knowledge (Khalil et al.,2021).

Therefore, the following hypothesis is framed by the authors:

H2: Leadership model that develops vision, hope/faith and altruistic love is positively related to employee's knowledge sharing in Indonesian universities.

Knowledge is vital to innovation, and innovation is a process of formulating problems and developing new knowledge to answer them. Knowledge sharing processes practised by organisational members assist them in translating the knowledge, create new procedures and psychological models, and solve problems (Arsawan et al., 2020). Spiritual leadership can help with turning knowledge and exchange the abilities and experiences that exist in individual minds. It can encourage and promote a knowledge sharing culture by ingraining admiration and respect. Leaders can mould team spirit by encouraging commitment and innovation (Fry and Nisiewicz, 2020). Utilising natural inspiration, strict and moral characteristics, leaders can give uncommon consideration to adherents, urging them to solve problems. The disseminated and accessible knowledge among organisational members will assist with producing groundbreaking thoughts, which can thus improve management innovation (Singh et al., 2021).

Although spiritual leadership may affect management innovation straightforwardly, research has recommended that the direct effects be too intricate to define (Stummer & Kiesling, 2021). Scholars have noticed inadequate instruments that may clarify these connections and have expected to address

and comprehended the processes through which spiritual leadership impacts innovation (Fry et al., 2017).

Therefore, this research contends that knowledge sharing plays a mediating role in connecting spiritual leadership and innovation. Thus, the authors propose the following hypothesis:

H3: Employee's knowledge sharing mediates the positive relationship between the leadership model that develops vision, hope/faith, altruistic love and management innovation in Indonesian universities.

## III. DATA AND METHODOLOGY

This study is a quantitative method aimed at testing and identifying variable dependency by analysing the interaction of spiritual leadership, management innovation and knowledge sharing in South Kalimantan, Indonesia. Respondents of 500 were lecturers from various fields of studies. The sample selection method uses convenience sampling based on the member's willingness to join in public university Whatsapp social media group to take part 750 lecturers listed in the group, and 500 responses (67%) are qualified for further processing. In SEM, as outlined by Hair et al. (2020), the minimum sample size is to have at least five times as many indicators to be analysed. As there are 39 indicators, a sample of 500 is within the acceptable sample range. The authors researched from January to December 2020. They measured spiritual leadership with 17 items from a questionnaire developed by Fry et al. (2017).

To measure knowledge sharing, the study used 14 items reflecting the exchange of teaching-related knowledge, experiences and skills among faculty. These items were from Hooff and Weenen (2004). Eight items to measure innovation were from two previous studies (Rajiani & Ismail, 2019; Al-Husseini et al., 2019). Respondents replied with a 5-point Likert Scale, ranging from 1 = strongly disagree to 5 strongly agree. To examine the relationship among construct, the study adopted PLS-SEM.

To evaluate discriminant validity, the authors applied a factor loading model where only items with factor loading and Average Variance Extracted (AVE) surpass 0.50 will stay in the model (Hair et al., 2020).

## IV. RESULTS AND DISCUSSION

As this research aimed to examine the impact of spiritual leadership on management innovation through the mediating role of knowledge sharing, structural equation modelling (SEM) was a suitable method to estimate these complex cause-effect relationships by analysing the questionnaire response. This process comprised two steps; creating a measurement model to evaluate the convergent validity of the constructs, followed by building a structural model to test and assess the total effects. SEM demands the estimation models validity by observing the factor loading and calculation of Average Variance Extracted (AVE) instead of the conventional "Cronbach's Alpha". The factor loading estimation and Average Variance Extracted (AVE) of 0.50 or higher shows a reasonable degree of validity (Hair et al., 2020). The estimation model in Table 1 shows that the loading factors and Average Variance Extracted (AVE) are all above 0.50, meaning that the instrument had satisfactory convergent validity.

**Table 1. Loading factors and AVE construct**

| Construct & AVE | Items | Loading Factors |
|---|---|---|
| Spiritual Leadership (AVE = 0.713) | 1. I am fully committed to my organisation's vision. | 0.820 |
| | 2. My workgroup's vision statement brings out the best in me. | 0.849 |
| | 3. My organisation's vision inspires my best performance. | 0.793 |
| | 4. I believe in my organisation's vision for its employees. | 0.802 |
| | 5. My organisation's vision is clear and compelling to me. | 0.627 |
| | 6. I am willing to "do whatever it takes" to ensure that it accomplishes its mission. | 0.621 |
| | 7. I persevere and exert effort to help my organisation succeed. | 0.673 |
| | 8. I always do my best in my work, for I believe in my organisation and its leaders. | 0.706 |
| | 9. I set challenging goals because I believe in my organisation. | 0.681 |
| | 10. I demonstrate my faith in my organisation mission by doing everything. | 0.704 |
| | 11. My organisation cares about its people. | 0.728 |
| | 12. My organisation is kind and considerate toward its workers. | 0.785 |
| | 13. The leaders in my organisation "walk the walk" as well as "talk the talk". | 0.732 |
| | 14. My organisation is trustworthy and loyal to its employees. | 0.731 |
| | 15. My organisation does not punish honest mistakes. | 0.586 |
| | 16. The leaders in my organisation are honest and without false pride. | 0.569 |
| | 17. The leaders in my organisation dare to stand up for their people. | 0.723 |

| | | | |
|---|---|---|---|
| Knowledge Sharing (AVE = 0.752) | 1. | Knowledge sharing with colleagues is considered common outside of my department. | 0.781 |
| | 2. | Knowledge sharing among colleagues is considered normal in my department. | 0.684 |
| | 3. | When I have learned something new, I tell colleagues outside of my department. | 0.678 |
| | 4. | When they have learned something new, my colleagues within my department tell me. | 0.713 |
| | 5. | I share information about the teaching profession with my colleagues at the university. | 0.653 |
| | 6. | I share information about administrative issues with my colleagues in the university. | 0.775 |
| | 7. | When I have learned something new regarding the teaching profession, I tell my colleagues in my department. | 0.748 |
| | 8. | When they have learned something new, colleagues outside of my department tell me. | 0.840 |
| | 9. | I share the information I have with colleagues within my department when they ask for it. | 0.765 |
| | 10. | Colleagues in my university share information about the teaching profession with me. | 0.725 |
| | 11. | Colleagues within my department share knowledge with me when I ask them. | 0.741 |
| | 12. | Colleagues within my department tell me what their skills are when I ask them. | 0.763 |
| | 13. | I share my skills with colleagues outside of my department when they ask me to. | 0.802 |
| | 14. | I share my skills with colleagues within my department when they ask for them. | 0.865 |
| Management Innovation (AVE=0.727) | 1. | Our university is developing new training programmes for staff members. | 0.801 |
| | 2. | Our university encourages teamwork and good working relationships between staff members. | 0.819 |
| | 3. | Our university is implementing an incentive system to encourage members of staff to come up with innovative ideas. | 0.814 |
| | 4. | Our university often develops new technology to improve the educational process. | 0.792 |
| | 5. | Our university often uses new technology to improve the educational process. | 0.625 |
| | 6. | This university uses new multimedia software for educational purposes and administrative operations. | 0.715 |
| | 7. | This university is implementing a reward system to encourage staff members to come up with innovative ideas. | 0.643 |
| | 8. | Our university is trying to bring in new equipment to facilitate educational operations and work procedures. | 0.611 |

The results of structural equation modelling are shown in Table 2. The table indicates that the entire paths are significant.

**Table 2. The Structural Equation Modeling results**

| Path | Path Coefficient | $R^2$ | P-Value | Conclusion |
|---|---|---|---|---|
| Spiritual leadership → management innovation | 0.693 | 0.33 | 0.00 | Significant |
| Spiritual leadership → knowledge sharing | 0.850 | 0.42 | 0.00 | Significant |
| Knowledge sharing → management innovation | 0.518 | 0.12 | 0.03 | Significant |
| Spiritual leadership → Knowledge sharing → management innovation | 0.746 | 0.53 | 0.05 | Significant |

The positive path coefficient value of spiritual leadership to management innovation = 0.693 and p-value = 0.000 confirms the first hypothesis: leadership model that develops vision, hope/faith and altruistic love is positively related to management innovation in Indonesian universities. Similarly, the positive path coefficient value of spiritual leadership to knowledge sharing = 0.850 and pvalue = 0.000 confirms the second hypothesis: leadership model that develops vision, hope/faith and altruistic love is positively related to employee's knowledge sharing in Indonesian universities. The path spiritual leadership >management innovation generates a coefficient of determination ($R\ 2$ ) = 0.33. But the path spiritual leadership >knowledge sharing >management innovation produce a coefficient of determination (R 2) = 0.53. The higher value confirms the third hypothesis that an employee's knowledge sharing mediates the positive relationship between leadership models that develop vision, hope/faith, and altruistic love and management innovation in Indonesian universities. The total effect generated is 0.693 x 0.850 x 0.518 = 0.3051 or 30.5%.

The model goodness of fit is measured with the Stone–Geisser Q-square test for predictive relevance (Chin, 2010) with the formula:

$$Q2 = 1 - (1 - R_1^2)(1 - R_2^2), \ldots (1 - R_p^2)$$

Where $R_1^2, R_2^2, \ldots R_p^2$ is the $R^2$ of endogen variables.

Thus, $Q\,2 = 1 - (1 - 0.33)(1 - 0.42)(1 - 0.12)(1 - 0.53)$

$= 1 - (0.67)(0.58)(0.79)(0.88)(0.47)$

$= 1 - 0.126 = 0.874$ (87.4%).

Since Q-squares is higher than 0.5, the predictive relevance requirement is satisfactory.

The results affirm leadership articulating vision, hope/faith, altruistic love, impact management innovation, and help provide a better comprehension of the linkages between leadership and innovation. This is significant as it shows that spiritual leadership can advance the generating of abilities not growing under the conventional leadership style. The results show that leaders in Indonesian colleges have the nature of this leadership through showing esteems, perspectives and conduct that can enable a sense of spiritual subsistence among faculty members (Fry and Nisiewicz, 2020). Personnel is more innovative because of undertaking curricula development and training programmes, research projects and embracing innovation when their chiefs make a feeling of completeness, harmony and prosperity created through care, concern and appreciation for themselves as other people. The findings of this investigation are consistent with the statement that leaders with altruistic love empower an adjustment of social qualities, prompting more incredible innovation (Hunsaker, 2020). Spiritual leadership can construct a trust-based culture inside educational institutes. Followers who feel trusted by their leaders will tune into others as well as ready to retain knowledge from them, with the outcome that they will, in general, be keen on sharing knowledge themselves.

These findings propose that faculty in Indonesian public HEIs accept that their leaders urge them to gather knowledge by exchanging views and utilising peer support for creating learning technologies and skills development. These results are consistent with Khalil et al. (2021), who pointed out that leaders who ingrain respect and trust can facilitate knowledge acquisition and sharing among organisational members.

The most significant contribution of this research is the acknowledgement of the mediating effect of knowledge sharing on the relationship between spiritual leadership and management innovation. This is because the Indonesian cultural environment does not support knowledge sharing. Knowledge sharing is thriving more in low power-distance cultures due to egalitarianism across a different chain of command in the organisation. At the same time, Indonesia belongs to a highpower distance society (Hofstede et al., 2015). Hussien & Khedr (2021) point out that low power distance is more favourable to knowledge sharing atmosphere because this type of society facilitates the informal knowledge sharing necessary for sharing tacit knowledge.

On the other hand, individuals in high power-distance cultures accept unequal distribution of higher authority. They are reluctant to share knowledge

across the chain of command due to their sensitivity to unequal power distribution. Collectivist Indonesia demonstrates a tight social bond in which people discriminate between in-groups and out-groups (Rajiani & Kot, 2020). In a collectivist society, members are more prepared to share knowledge if they belong to the in-group and not willing to share knowledge with members not acknowledged to the group (Stoermer et al., 2021). People hide knowledge, mainly tacit if intense competition exists between professionals inside (Hussien & Khedr, 2021). This is associated with the cultural dimension of masculinity. In this culture, status and power are central values, and people may consider losing their power if they share their special knowledge. Indonesia scores 49 out of 50 (Hofstede et al., 2015) in masculinity, which means academia is vulnerable to hiding the knowledge due to high competition in producing high-quality articles in reputable journals.

Bandura's social cognitive hypothesis (Chai and Shi, 2020) demonstrates that the collaboration among people's insight, people's conduct and the environment is steady. In the Indonesian setting, leaders' behaviour assumes a focal role in affecting employees' behaviour (Rajiani & Kot, 2020); likewise, employees' sharing knowledge behaviour is slowly framed through social learning and cognition processes in a setting where leaders have a solid demonstration impact on employees. In this case, a clear, stimulating vision as a spiritual leadership element drives employees toward similar objectives. It increases their feeling of obligation to the organisation, which, in turn, generates favourable behaviours. The practice of spiritual leadership has proven to move the cultural barriers when encouraging academia to share the knowledge with colleagues to be innovative in conducting something in a new way.

Managerial Implications Since organisations keep on redeploying resources to preserve their corporate sustainability (Strakova et al., 2020), the current study has implications for enhancing the sustainability of organisations. Because knowledge sharing has positive effects on putting forward new ideas reflected in management innovation, it is incredibly beneficial for apprehending the sustainability of organisations. To motivate knowledge sharing, organisations should encourage leaders to engage in spiritual leadership by developing their values and behaviours, enhancing the demonstration effect. In the Indonesian setting, Ki Hadjar Dewantara, the father of Indonesian educational model, has coined these behaviours with the concept known as "Tri Pakarti Utama " - three pre-eminent attitudes: Ing Ngarso Sung Tulodo, Ing Madyo Mangun Karso, Tut Wuri Handayani (one has to set an example, when one is in a front position, to stimulate when in the middle, and to support when at the rear). It is believed that

the three pre-eminent attitudes are the authentic spiritual leadership practice in universities that must guide the behaviour of university leaders.

## V. CONCLUSION

The present study investigated the relationships among spiritual leadership, employee knowledge sharing and management innovation. It is found that spiritual leadership has motivational influences on followers by promoting their sense of wholeness, harmony and well-being produced through care, concern and appreciation for both self and others. Furthermore, spiritual leadership delivers an inspiring vision to followers and motivates them to do something in a new way.

Consequently, employees develop positive attitudes and behaviours toward the organisation. They are willing to participate in knowledge sharing, which is not a norm in collectivist and high power distance societies. Overall, these findings indicate the strong effect of spiritual leadership and show employees' innovativeness during the covid pandemic.

Furthermore, the authors examined this issue in Indonesia's new developed economic system, which augments relevant research in ASEAN countries and provides insight for other Eastern or developing countries. Despite the exertion the researchers put into the plan of the current investigation, it is not without restrictions. First of all, a typical constraint of this kind of study is self-selection bias. Specifically, people with an earlier interest in research are bound to react to such an overview. Besides, the examination was exploratory and cross-sectional, making it hard to build up causal connections between the factors of the proposed model. In this way, the study has suggested that spiritual leadership and knowledge sharing predict management innovation among lecturers. But in any case, it could be that the relationship is vice versa, i.e., that the willingness to initiate management innovation of lecturers is what determines the potential spiritual leaders and knowledge sharing. It would along these lines be recommendable to do a longitudinal report that could affirm the causal connections that presented themselves.

## REFERENCES

Ahadiat, A., Dacko-Pikiewicz, Z., (2020). Effects of ethical leadership and employee commitment on employees' work passion. *Polish Journal of Management Studies,* 21(2), 24-35.

Al-Husseini, S., El Beltagi, I. and Moizer, J., (2019). Transformational leadership and innovation: the mediating role of knowledge sharing amongst higher education faculty. *International Journal of Leadership in Education*, 1-24.

Ali, M., Aziz, S., Pham, T. N., Babalola, M. T. and Usman, M., (2020). A positive human health perspective on how spiritual leadership weaves its influence on employee safety performance: The role of harmonious safety passion. *Safety Science,* 131, 104923.

Archanjo de Souza, D. S. D. O., Pedro Salgado, A. M., Marins, F. A. S. and Muniz, J., (2020). The influence of leaders' characteristics on the relationship between leadership and knowledge management. *Knowledge Management Research & Practice*, 1-12.

Arsawan, I. W. E., Rajiani, I. and Suryantini, S. P., (2018). Investigating knowledge transfer mechanism in five star hotels. *Polish Journal of Management Studies*, 18(2), 22-32.

Bhatti, M. H., Akram, U., Bhatti, M. H., Rasool, H. and Su, X. (2020). Unraveling the Effects of Ethical Leadership on Knowledge Sharing: The Mediating Roles of Subjective Well-Being and Social Media in the Hotel Industry. *Sustainability*, 12(20), 1-20.

Bonett, D. G., Wright, T. A. (2015)., Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organizational Behavior*, 36(1), 3-15.

Cai, Y., Shi, W., (2020). The influence of the community climate on users' knowledgesharing intention: the social cognitive theory perspective. *Behaviour & Information Technology*, 1-17.

Chin, W. W., (2010). *Bootstrap cross-validation indices for PLS path model assessment*. In Handbook of partial least squares (pp. 83-97), Berlin: Springer.

Connelly, C. E., Cerne, M., Dysvik, A. and Škerlavaj, M., (2019). Understanding knowledge hiding in organisations. Journal of Organizational Behavior, 40(7), 779- 782.

Fry, L. W., Latham, J. R., Clinebell, S. K. and Krahnke, K., (2017). Spiritual leadership as a model for performance excellence: a study of Baldrige award recipients. *Journal of Management, Spirituality & Religion*, 14(1), 22-47.

Fry, L. W., Nisiewicz, M. S., (2020). *Chapter Two. The Spiritual Leadership Model*. In Maximising the Triple Bottom Line Through Spiritual Leadership (pp. 33-56), Stanford, CA: Stanford University Press.

Gaus, N., Basri, M., Thamrin, H. and Ritonga, F. U., (2020). Understanding the nature and practice of leadership in higher education: a phenomenological approach. *International Journal of Leadership in Educatio*n, 1-19.

Gerlach, F., Hundeling, M. and Rosing, K., (2020). Ambidextrous leadership and innovation performance: a longitudinal study. *Leadership and Organization Development Journal*, 41(3), 383-398.

Gupta, S., (2020). Higher Education Management, Policies and Strategies. *Journal of Business Management & Quality Assurance* (e ISSN 2456-9291), 1(1), 5-11.

Hair Jr, J. F., Howard, M. C. and Nitzl, C., (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, 109, 101-110.

Hayat Bhatti, M., Akram, U., Hasnat Bhatti, M., Rasool, H. and Su, X., (2020). Unraveling the Effects of Ethical Leadership on Knowledge Sharing: The Mediating Roles of Subjective Well-Being and Social Media in the Hotel Industry. *Sustainability*, 12(20), 1-20.

Hofstede, G., Hofstede, G. J. and Minkov, M., (2015). Cultures and organisations: pyramids, machines, markets, and families: organising across nations. *Classics of Organization Theory*, 314(23), 701-704.

Hooff, V., Weenen, F., (2004). Committed to share: Commitment and CMC use as antecedents of knowledge sharing. Knowledge and Process Management, 11(1), 13–24.

Hunsaker, W. D., (2020). Spiritual leadership and employee innovation. *Current Psychology*, 1-10.

Ismail, N., Kot, S., Abd Aziz, A. S. and Rajiani, I., (2020). From innovation to market: integrating university and industry perspectives towards commercialising research output. *Forum Scientiae Oeconomia*, 8(4), 99-115.

Karadag, M., Altinay Aksal, F., Altinay Gazi, Z. and Dagli, G., (2020). *Effect Size of Spiritual Leadership: In the Process of School Culture and Academic Success*. SAGE Open, 10(1), 2158244020914638.

Mol, M. J., (2018). Reflections on “the sources of management innovation” Mol & Birkinshaw, 2009. J*ournal of Global Scholars of Marketing Science*, 28(3), 278-281.

Nawaz N., Durst S., Hariharasudan, A., Shamugia Z. (2020). Knowledge Management Practices in Higher Education Institutions - A Comparative Study. *Polish Journal of Management Studies*. 22 (2), 291-308.

Novak, A., Breznik, K. and Natek, S., (2020). How leaders can initiate knowledge management in organisations: Role of leadership style in building knowledge infrastructure. *Human Systems Management*, 39(1), 37-50.

Oh, J., Wang, J., (2020). Spiritual leadership: Current status and Agenda for future research and practice. *Journal of Management, Spirituality & Religion*, 17(3), 223-248.

Hussien, S. and Khedr, W., (2021). The Effect of National Culture on Knowledge Sharing: Empirical Study on University Students in UK. *Arab Journal of Administration*, 41(1), 369-388.

Pangarso, A., Astuti, E. S., Raharjo, K. and Afrianty, T. W., (2020). The impact of absorptive capacity and innovation ambidexterity on sustainable competitive advantage: the case of Indonesian higher education. *Entrepreneurship and Sustainability Issues*, 7(3), 2436.

Prasodjo, T., (2020). Knowledge Management: Sustainable Human Resource Development in Public Sector Organizations. *Jurnal Ad'ministrare*, 6(2), 159-166.

Rajiani, I., Ismail, N., (2019). Management innovation in balancing technology innovation to harness universities performance in the era of community 4.0. *Polish Journal of Management Studie*s, 19(1), 309-321.

Rajiani, I., Kot, S., (2020). Javanese Indonesia: Human Resource Management Issues in a Uniquely Collectivist Culture. *Cultural Managemen*t, 4(2), 9-21.

Setini, M., Yasa, N. N. K., Gede Supartha, I. W., Ketut Giantari, I. and Rajiani, I., (2020). The passway of women entrepreneurship: Starting from social capital with open innovation, through to knowledge sharing and innovative performance. *Journal of Open Innovation: Technology, Market, and Complexity*, 6(2), 25.

Singh, S. K., Mazzucchelli, A., Vessal, S. R. and Solidoro, A., (2021). Knowledge-based HRM practices and innovation performance: Role of social capital and knowledge sharing. *Journal of International Management*, 27(1), 100830.A

Stamou, A., (2017). Knowledge management in doctoral education toward knowledge economy. *International Journal of Educational Management*, 31 (3), 320-331.

Stoermer, S., Davies, S. and Froese, F. J., (2021). The influence of expatriate cultural intelligence on organisational embeddedness and knowledge sharing: The moderating effects of host country context. *Journal of International Business Studies*, 52(3), 432- 453.

Straková, J., Rajiani, I., Pártlová, P., Váchal, J. and Dobrovic, J., (2020). Use of the Value Chain in the Process of Generating a Sustainable Business Strategy on the Example of Manufacturing and Industrial Enterprises in the Czech Republic. *Sustainability*, 12(4), 1-15.

Stummer, C., Kiesling, E., (2021). An agent-based market simulation for enriching innovation management education. Central European Journal of Operations Research, 29(1), 143-161.

Szczepanska-Woszczyna, K., Kurowska-Pysz, J., (2016). *Sustainable business development through leadership in SMEs*. Engineering Management in Production and Services, 8(3), 57-69.

Tang, G., Chen, Y., van Knippenberg, D. and Yu, B., (2020). Antecedents and consequences of empowering leadership: Leader power distance, leader perception of team capability, and team innovation. *Journal of Organizational Behavior*, 41(6), 551- 566.

Veer-Ramjeawon, P., Rowley, J., (2020). *Embedding knowledge management in higher education institutions (HEIs): a comparison between two countries*. Studies in Higher Education, 45(11), 2324-2340.

Yang, M., Fry, L. W., (2018). The role of spiritual leadership in reducing healthcare worker burnout. J*ournal of Management, Spirituality & Religion*, 15(4), 305-324.

Zuraik, A., Kelly, L., (2019). The role of CEO transformational leadership and innovation climate in exploration and exploitation. *European Journal of Innovation Management*, 22 (1), 84-104.

# 16. Analisis Sif Kerja, Masa Kerja, dan Budaya Keselamatan dan Kesehatan Kerja dengan Fungsi Paru Pekerja Tambang Batu Bara

Qomariyatus Sholihah[1], Aprizal Satria Hanafi[2], Wanti[3], Ahmad Alim Bachri[4], Sutarto Hadi[5]

[1,2.4,5] Universitas Lambung Mangkurat, Indonesia,
[3]Politeknik Kesehatan Kupang, Indonesia

**ABSTRAK**

Penambangan batu bara merupakan salah satu sumber pencemaran udara berupa partikel debu batu bara yang dapat mengganggu kesehatan pernapasan bila terhirup manusia. Risiko kerja yang sering terjadi dapat berasal dari faktor pekerjaan atau perilaku pekerja sendiri, di antaranya sif kerja dan masa kerja. Tujuan penelitian adalah untuk mengetahui hubungan sif ker- ja, masa kerja, dan budaya keselamatan dan kesehatan kerja (K3) dengan fungsi paru pekerja tambang batu bara. Penelitian ini merupakan desain ka- sus kontrol dengan jumlah masing-masing sampel untuk kasus dan kontrol sebesar 178 responden. Penelitian dilakukan pada bulan Oktober - November 2014 di PT. X Kalimantan Selatan. Hasil penelitian berdasarkan uji kai kuadrat, didapatkan nilai p = 0,044 untuk sif kerja, 0,028 untuk masa kerja, dan 0,013 untuk budaya K3. Berdasarkan hasil uji regresi logistik, di- dapatkan nilai p sif kerja 0,01 dengan OR = 3,934. Dapat disimpulkan bah- wa terdapat hubungan antara sif kerja dengan fungsi paru, dan tidak ter- dapat hubungan antara masa kerja dan budaya K3 dengan fungsi paru. Sif kerja merupakan variabel independen yang paling dominan memengaruhi fungsi paru.

Kata kunci: Fungsi paru, keselamatan dan kesehatan kerja, masa kerja, sif kerja

## I. PENDAHULUAN

Keselamatan dan kesehatan kerja (K3) merupakan suatu upaya untuk menciptakan suasana bekerja yang aman, nyaman, dan tujuan akhirnya adalah menciptakan produktivitas setinggi-tingginya. K3 mutlak untuk dilak- sanakan pada setiap jenis bidang pekerjaan tanpa kecuali. Pelaksanaan K3 dapat mengurangi kecelakaan kerja se- hingga dapat meningkatkan efisiensi dan produktivitas kerja.[1]

Penambangan batu bara merupakan salah satu sum- ber pencemaran udara yang dihasilkan dari partikel debu batu bara. Partikel debu tersebut dapat menyebabkan gangguan pernapasan bila terhirup manusia. Risiko ker- ja yang sering terjadi dan banyak menimbulkan kerugian adalah penyakit paru kerja yang timbul akibat pajanan debu batu bara dalam jangka waktu lama, yaitu pnemokoniosis, bronkitis kronis, dan asma kerja.[2,3]

Setiap tahun di seluruh dunia, dua juta orang meng-alami penyakit akibat kerja. Dari jumlah tersebut, terdapat 40.000 kasus baru pneumokoniosis.[4] Menurut International Labor Organization (ILO) tahun 2013, 2,34 juta orang meninggal setiap tahunnya karena penyakit akibat kerja. Di Jepang, pada tahun 2011, salah satu penyakit akibat kerja yang paling besar angkanya adalah pneumokoniasis, sama halnya dengan di Inggris.[5] Angka sakit di Indonesia mencapai 70% dari pekerja yang terpapar debu tinggi. Sebagian besar penyakit paru akibat kerja memiliki akibat yang serius, yaitu terjadinya gangguan fungsi paru dengan gejala utama yaitu sesak napas.[6]

Kejadian penyakit akibat kerja tersebut diperkirakan akibat dari faktor ekstrinsik seperti faktor lingkungan dan faktor perusahaan serta faktor intrinstik seperti peri- laku, sikap, dan kedisiplinan.[7] Penerapan implementasi program K3 akan memberikan pengaruh yang signifikan terhadap peningkatan produktivitas kerja.[8]

Salah satu faktor yang menyebabkan gangguan fungsi paru adalah sif kerja. Pekerja tambang batu bara memi- liki waktu sif siang (pagi, siang, sore) dan sif malam. Permasalahan lebih banyak terjadi pada pekerja sif malam karena irama faal tubuh manusia yang tidak da- pat menyesuaikan kerja malam dan tidur.[9] Kerja sif malam merupakan sistem yang berlawanan dengan irama sirkadian. Kelainan pola tidur sebagai salah satu bentuk gangguan irama sirkadian yang dialami pekerja sif memi- liki konsekuensi patologis berupa peningkatan kadar sitokin proinflamasi dalam darah karena penurunan sis- tem kekebalan dan antioksidan dalam tubuh.[10]

Penyakit pernapasan tidak hanya disebabkan oleh debu saja, melainkan dari karakteristik individu seperti masa kerja yang terkait dengan tingkat pajanan. Masa kerja penting diketahui untuk melihat lamanya seseo- rang telah terpajan dengan debu lingkungan. Selain itu, kebiasaan merokok juga merupakan salah satu kebi- asaan buruk yang dapat mengganggu kesehatan peker- ja. Seorang perokok memiliki risiko kematian 20 kali lebih besar akibat kanker paru dibandingkan yang bukan perokok.[11] Seseorang yang semakin lama beker- ja pada tempat yang mengandung debu, akan semakin tinggi risiko untuk terkena gangguan kesehatan, teruta- ma gangguan saluran pernapasan.[12] Penelitian yang di- lakukan pada pekerja tambang batu bara di Kalimantan Timur tahun 2012 diperoleh sebanyak 45,1% yang mengalami gangguan fungsi paru obstruktif dengan masa kerja > 5 tahun dan 16,7% yang masa kerjanya < 5 tahun.[13] Menurut Kaligis,[8] implementasi program K3 akan memberikan pengaruh yang signifikan terhadap peningkatan produktivitas kerja. Impelementasi K3 mampu mengurangi angka kecelakaan kerja sehingga pekerja dapat bekerja dengan lebih baik dan mengu- rangi angka absensi kerja akibat kecelakaan kerja atau penyakit akibat kerja.

Berdasarkan data yang diperoleh dari audit internal PT X tahun 2014, kadar debu di bagian produksi mencapai 4,8 mg/m$^3$. Sedangkan menurut National Institute of Occupational Safety and Health (NIOSH) tahun 2011, nilai ambang batas untuk debu batu bara adalah 2 mg/m$^3$. Debu tersebut akan meningkatkan risiko gang- guan paru pada pekerja tambang. Semakin lama seorang pekerja terpajan, maka risiko gangguan paru akan se- makin meningkat jika tidak disertai dengan penerapan K3 yang baik.[14]

Berdasarkan hasil data klinik di PT X didapatkan penyakit pekerja adalah sesak napas, common cold, dan flu. Penelitian tentang kesehatan pekerja di tambang batu bara PT X perlu dilakukan agar dapat diketahui penye- bab keluhan pekerja dan diharapkan dapat memini- malkan penyakit akibat kerja dan tujuan akhirnya dapat meningkatkan produktivitas pekerja. Tujuan umum penelitian ini adalah untuk mengetahui hubungan sif ker- ja, masa kerja, dan budaya K3 dengan fungsi paru peker- ja tambang batu bara di PT X.

## II. METODE

Desain studi yang digunakan pada penelitian ini adalah kasus kontrol untuk mengamati variabel depen- den, yaitu gangguan fungsi paru dan variabel indepen- den, yaitu sif kerja, masa kerja, dan budaya K3. Pada penelitian ini

digunakan perbandingan kasus dan kontrol adalah 1 : 1 sehingga jumlah kontrol sebanyak 178 orang. Maka, jumlah sampel yang dibutuhkan pada penelitian ini adalah 356 orang. Sampel diambil menggunakan teknik simple random sampling. Sampel kelompok kasus adalah seluruh pekerja tambang batu bara PT X bagian produksi yang berjumlah 178 orang, sedangkan sampel kelompok kontrol adalah karyawan bagian manajemen kantor berjumlah 178 orang.

Instrumen dalam penelitian ini adalah lembar isian (data identitas dan kuesioner) dengan disertai persetu- juan menjadi subjek penelitian, alat uji fungsi paru (Spirometri) merek BLT-08 Spiro Pro Meter® dan mouthpiece, timbangan berat badan untuk mengukur be- rat badan, dan meteran untuk mengukur tinggi badan. Pengukuran menggunakan instrumen didampingi oleh petugas medis dari pihak perusahaan. Kuesioner dibagikan kepada responden untuk mengukur budaya K3 responden, kemudian fungsi paru responden diukur de- ngan menggunakan spirometri dan mouthpiece. Hasil dikatakan normal jika besar volume udara yang dike- luarkan dalam satu detik pertama e" 80% dari kapasitas fungsi paru dan dikatakan tidak normal jika < 80% dari kapasitas fungsi paru. Sedangkan lembar isian digunakan untuk mengetahui sif kerja dan masa kerja. Data dianali- sis menggunakan uji kai kuadrat dengan alpha 95%, ke- mudian dilanjutkan dengan analisis regresi logistik untuk analisis multivariat dengan variabel sif kerja, masa kerja, dan budaya K3. Penelitian ini dilakukan pada bulan Oktober – November 2014 di PT X.

## III. HASIL

Hasil distribusi sif kerja, masa kerja, budaya K3 dan fungsi paru pada pekerja tambang di PT X sinergi pada Tabel 1. Tabel 1 memaparkan hasil berdasarkan analisis univariat untuk mendapatkan distribusi fekuensi dari masing-masing variabel independen (sif kerja, masa ker- ja, dan budaya K3) dan variabel dependen (gangguan fungsi paru). Hasil penelitian menunjukkan kasus fungsi paru tidak normal sebesar 57,9% meliputi obstruktif, re- struktif maupun keduanya.

Tabel 2 menunjukkan hubungan antarvariabel inde- penden dengan variabel dependen. Seluruh variabel meliputi sif dan masa kerja, serta budaya 3 memiliki hubungan yang bermakna secara statistik dengan nilai $p< 0,05$. Variabel bebas yang berhubungan dengan vari- abel terikat (variabel sif kerja, masa kerja, dan budaya K3) bersama dimasukkan dalam perhitungan uji regresi logistik metode Enter. Sif kerja merupakan variabel be- bas yang berpengaruh paling dominan dengan fungsi paru (Tabel 3).

Tabel 1. Distribusi Frekuensi Kasus dan Kontrol Berdasarkan Variabel Independen

| Variabel | Kategori | Kasus | Kontrol | Total |
|---|---|---|---|---|
| Sif kerja | Siang | 98 (55,1%) | 141 (79,2%) | 239 (67,1%) |
| | Malam | 80 (44,9%) | 37 (20,8%) | 117 (32,9%) |
| Masa kerja | <5 Tahun | 118 (66,3%) | 43 (24,2%) | 161 (45,2%) |
| | ≥5 Tahun | 60 (33,7%) | 135 (75,8%) | 195 (54,8%) |
| Budaya K3 | Positif | 108 (60,1%) | 172 (96,6%) | 280 (78,7%) |
| | Negatif | 70 (39,9%) | 6 (3,4%) | 76 (21,3%) |
| Fungsi paru | Normal | 75 (42,1%) | 163 (91,6%) | 238 (66,9%) |
| | Tidak normal (obstruktif, restruktif, campuran) | 103 (57,9%) | 15 (8,4%) | 118 (33,1%) |

Tabel 2. Analisis Bivariat Variabel Independen dengan Fungsi Paru

| Variabel | Kategori | Kasus | Kontrol | Total | OR 95% CI | Nilai p |
|---|---|---|---|---|---|---|
| Sif kerja | Siang | 98 (55,1%) | 141 (79,2%) | 239 (67,1%) | 6,326 | 0,044 |
| | Malam | 80 (44,9%) | 37 (20,8%) | 117 (32,9%) | 1,829-21,001 | |
| Masa kerja | < 5 Tahun | 118 (66,3%) | 43 (24,2%) | 161 (45,2%) | 4,82 | 0,028 |
| | ≥ 5 Tahun | 60 (33,7%) | 135 (75,8%) | 195 (54,8%) | 1,743-13,239 | |
| Budaya K3 | Positif | 108 (60,1%) | 172 (96,6%) | 280 (78,7%) | 5,532 | 0,013 |
| | Negatif | 70 (39,9%) | 6 (3,4%) | 76 (21,3%) | | |

Tabel 3. Hasil Uji Multivariat Fungsi Paru

| Variabel Bebas | B | Wald | Sig | Exp (B) | 95% CI for EXP (B) | |
|---|---|---|---|---|---|---|
| | | | | | *Lower* | *Upper* |
| Sif kerja | 1,360 | 7,074 | 0,01 | 3,934 | 1,453 | 2,864 |
| Masa kerja | 0,893 | 2,899 | 0,076 | 2,454 | 0,786 | 7,567 |
| Budaya K3 | 1,006 | 6,655 | 0,081 | 2,675 | 0,965 | 6,654 |

## IV. PEMBAHASAN

Hasil penelitian dengan menggunakan uji kai kuadrat menunjukkan terdapat hubungan antara sif kerja dan fungsi paru pekerja tambang batu bara dikarenakan nilai p < 0,05. Dalam penelitian ini, terdapat bahwa kapasitas fungsi paru pekerja tambang batu bara sif siang ada yang mengalami penurunan kapasitas fungsi paru di bawah ni- lai normal, yaitu FEV1 80%. Hal ini sesuai dengan penelitian Hendryx and Melissa,[15] membuktikan bahwa risiko tinggi pekerja tambang batu bara terhadap ter- jadinya inamasi yang menyebabkan risiko gangguan fungsi paru. Dibuktikan oleh penelitian Sari Mumuya,[16] pada tahun 2006 terhadap 299 laki-laki pekerja tambang batu bara sif siang di Tanzania dengan nilai p = 0,04 (ni- lai p < 0,05) menunjukkan bahwa risiko bekerja di dae- rah pertambangan batu bara dapat menurunkan nilai FEV1% 80.

Berdasarkan data yang diperoleh, terdapat nilai kapa- sitas fungsi paru pekerja tambang batu bara sif malam mengalami penurunan dibandingkan sif siang. Penurunan kapasitas fungsi paru lebih banyak ditemukan pada pekerja tambang batu bara sif malam. Sif malam menun- jukkan penurunan FEV1%, Vmax50, Vmax25 lebih be- sar dibandingkan dengan sif pagi dan sif siang.

Menurut Zheng,[10] sif malam merupakan sistem yang berlawanan dengan ritme sirkadian. Kelainan pola tidur sebagai salah satu bentuk gangguan ritme sirkadian yang dialami pekerja sif memiliki konsekuensi patologis berupa pe- ningkatan kadar sitokin proinamasi dalam darah kare- na penurunan sistem kekebalan dan antioksidan dalam tubuh. Hal ini didukung oleh penelitian Sholihah,[17] membuktikan bahwa dinding alveoli tikus wistar yang dikondisikan sif malam mengalami penebalan lebih sig- nifikan dibandingkan sif siang. Penurunan kapasitas fungsi paru dapat disebabkan kondisi fisik individu pekerja yang meliputi mekanisme pertahanan paru, anatomi dan fisiologi saluran pernapasan serta faktor imunologis.[18] Dibuktikan oleh penelitian Siyoum,[19] pa- da tahun 2014 di Etiopia dengan nilai p = 0,001 yang menjelaskan bahwa gejala gangguan fungsi paru terjadi lebih banyak pada pekerja sif malam dibandingkan de- ngan sif lainnya.

Hasil penelitian dengan menggunakan uji kai kuadrat menunjukkan bahwa terdapat hubungan antara masa kerja dan fungsi paru pekerja tambang batu bara, dikare- nakan nilai p > 0,05. Penelitian ini tidak sejalan dengan penelitian Puspita dkk,[20] mengenai pengaruh paparan debu batu bara terhadap gangguan faal paru. Hasil anali- sis faktor risikonya menunjukkan bahwa masa kerja tidak memiliki hubungan terhadap kejadian gangguan faal paru. Dalam penelitian Baharuddin dkk,[21] masa kerja 2- 7 tahun dan 8 - 13 tahun juga tidak memiliki hubungan dengan gangguan fungsi paru, baru pada masa kerja 14 - 20 tahun mulai terdapat hubungan dengan gangguan fungsi paru. Beberapa penelitian melaporkan bahwa di negara yang telah memiliki nilai ambang batas debu, pneumokoniosis pada penambang batu bara biasanya terjadi pada individu yang telah bekerja selama > 10 tahun atau paling sedikit 5 - 10 tahun. Hal ini menun- jukkan bahwa terdapat bukti yang signifikan antara masa kerja dengan fungsi paru. Jika masa kerja berhubungan, diperlukan waktu paparan yang cukup lama untuk dapat menimbulkan kelainan pada faal paru. Jumlah total suatu zat yang diabsorsi di paru-paru bukan hanya tergantung pada lamanya seseorang terpapar dengan debu saja, na- mun perlu diperhitungkan sifat-sifat kimia dan fisik dari debu itu sendiri yang terhirup oleh pekerja.[22]

Penurunan fungsi paru tidak hanya disebabkan oleh faktor pekerjaan maupun lingkungan kerja, tetapi juga terdapat sejumlah faktor nonpekerjaan yang dapat men- jadi faktor yang memengaruhi maupun menjadi variabel pengganggu. Hal-hal yang dapat memengaruhi seperti usia, jenis kelamin, kelompok etnis, tinggi badan, kebi- asaan merokok, suhu lingkungan, penggunaan alat pelin- dung diri, metode pengolahan serta jumlah jam kerja/jam giliran kerja (sif kerja).[23]

Faktor lain dalam penelitian ini yang menyebabkan masa kerja menjadi tidak berhubungan dengan fungsi paru adalah kadar debu. Pada penelitian ini, kadar debu batu bara merupakan faktor pengganggu yang tidak da- pat dikendalikan karena setiap hari semua pekerja tam- bang batu bara di bagian produksi berkontak langsung dengan debu batu bara.

Hasil penelitian ini menunjukkan terdapat hubungan antara budaya K3 dan fungsi paru pekerja tambang batu bara dikarenakan nilai $p > 0,05$. Penelitian ini sesuai de- ngan penelitian terdahulu yang dilakukan oleh Duma dkk,[1] yang mendesain modul menuju selamat sehat se- bagai metode dan media penyuluhan K3 yang efektif meningkatkan pengetahuan, sikap dan perilaku K3 (bu- daya K3) serta tenaga kerja inovatif dalam pengendalian gangguan kesehatan. Hasil penelitian menyatakan penyu- luhan K3 dalam penerapannya selama satu tahun efektif meningkatkan pengetahuan dan sikap budaya K3, na- mun belum efektif meningkatkan kesehatan pekerja. Berdasarkan hasil observasi di PT X, Rantau, Kalimantan Selatan, nilai ambang batas debu tidak diketahui. Manajemen perusahaan tambang batu bara hanya menya- takan secara lisan bahwa nilai ambang batas debu dalam keadaan normal.[24] Kadar debu lebih dari 350 mg/ $m^3$ udara/hari (OR = 2,8; 95% CI = 1,8 - 9,9) merupakan salah satu faktor intrinsik yang terbukti berhubungan dengan penurunan kapasitas paru.[6]

Berdasarkan kepustakaan, debu yang berukuran an- tara 5 - 10 mikron bila terhisap akan tertahan dan ter- timbun pada saluran napas bagian atas, yang berukuran antara 3 - 5 mikron tertahan atau tertimbun pada saluran napas tengah. Partikel debu dengan ukuran 1 - 3 mikron disebut debu respirabel merupakan yang paling berba- haya karena tertahan atau tertimbun mulai dari bronkio- lus terminalis sampai alveoli.[25]

## V. KESIMPULAN

Hasil penelitian menunjukkan terdapat hubungan sif kerja, masa kerja, dan budaya K3 dengan fungsi paru pekerja tambang batu bara PT X di Kalimantan Selatan.

## DAFTAR PUSTAKA

1. Duma K, Husodo AH, Soebijanto, Maurits LS. Modul menuju selamat sehat: inovasi penyuluhan kesehatan dan kesehatan kerja dalam pengendalian kelelahan kerja. Jurnal Manajemen Pelayanan Kesehatan. 2011; 14 (4): 213-23.

2. Rikmiarif DE, Pawenang ET, Cahyati WH. Hubungan pemakaian alat pelindung pernafasan dengan tingkat kapasistas vital paru. Unnes Journal of Public Health. 2012; 1 (1): 12-7.
3. Hermanus MA. Occupational health and safety in mining–status, New developments, and concerns. The Journal of the Southern African Institute of Mining and Metalurgy. 2007; 107: 531-8.
4. Susanto AD. Pnemokoniosis: artikel pengembangan pendidikan kepro- fesian berkelanjutan. Journal of Indonesian Medical Association. 2011; 61: 503-10.
5. ILO [homepage in internet]. The prevention of occupational diseases. World day for safety and health at work. 2013 [cited 2014 Dec 5]. Available from: http://www.ilo.org/safework/events/meetings/ WCMS_204594/lang—en/ index.htm
6. Meita AC. Hubungan paparan debu dengan kapasitas vital paru pada pekerja penyapu Pasar Johar Kota Semarang. Jurnal Kesehatan Masyarakat. 2012; 1 (2): 654-62.
7. Susilowati IH, Syaaf RZ, Satrya C, Hendra, Baiduri. Pekerjaan, non pekerjaan, dan psikologi sebagai penyebab kelelahan operator alat Berat di industri pertambangan batubara. Kesmas: Jurnal Kesehatan Masyarakat Nasional. 2013; 8 (2): 91-6.
8. Kaligis RSV, Sompie BF, Tjakra J, Walangitan DRO. Pengaruh imple- mentasi program keselamatan dan kesehatan kerja (K3) terhadap pro- duktivitas kerja. Jurnal Sipil Statik. 2013; 1 (3) : 219-25.
9. Siyoum K, Alemu K, Kifle M. Respiratory symptoms and associated factors among cement workers and civil servants In North Shoa, Oromia regional state, North West Ethiopia: comarative cross sectional study. Journal Health Affairs. 2014; 2 (4): 74 - 8.
10. Zheng H, Patel M, Hryniewicz K, Katz SD. Association of extended shift work, vascular fuction and inflammatory markers in internal medicine resident: a randomized control trial. JAMA. 2006; 296 (9): 1049-54.
11. Kandung RPB. Hubungan antara karakteristik pekerja dan pemakaian alat pelindung pernapasan (masker) dengan kapasitas fungsi paru pada pekerja wanita bagian pengempelasan di Industri Mebel "X" Wonogiri. Jurnal Kesehatan Masyarakat. 2013; 2 (1).

12. Putra DP, Rahmatullah P, Novitasari A. Hubungan usia, lama kerja, dan kebiasaan merokok dengan fungsi paru pada juru parkir di Jalan Pandanaran Semarang. Jurnal Kedokteran Muhammadiyah. 2012; 1 (3): 7-12.

13. Cahyana A. Faktor yang berhubungan dengan kejadian gangguan fungsi paru pada pekerja tambang batubara PT. Indominco Mandiri Kalimantan Timur Tahun 2012 [research article]. Makassar: Bagian Kesehatan dan Keselamatan Kerja FKM Universitas Hasanuddin, 2012.

14. National Institute for Occupational Safety and Health . Coal mine dust exposures and associated health outcomes. NIOSH [online]; 2011 [cit- ed 2015 Jan 4]. Available from: www.cdc.gov/niosh/docs/2011- 172/pdfs/2011-172.pdf.

15. Hendryx M, Melissa M. Relations between health indicators and resi- dential proximity to coal mining in West Virginia. American Journal of Public Health. 2008; 98 (4): 668-71.

16. Mumuya SHD, Bratveit M, Mashalla YJ, Moen BE. Airflow limitation among workers in a labour-intensive coal mine in Tanzania. Journal of

Occupational Medicine. 2007; 36 (2): 299-306.

17. Sholihah Q. Melatonin lowers levels of SOD and number of inflamma- tory cells BAL wistar strain mice wearing mask PPE, sub acute exposed by coal dust day and night. Journal Applied Environment Biological Science. 2012; 2 (12): 652-7.

18. Raju AE, Hansi K, Sayaad R. A Study on pulmonary function tests in coal mine workers in Khammam District India. International Journal Physioter Respiratory Research. 2014; 2 (3): 502-6.

19. Siyoum K, Alemu K, Kifle M. Respiratory symptoms and associated factors among cement workers and civil servants in North Shoa, Oromia Regional State, North West Ethiopia: Comarative Cross Sectional Study. Journal Health Affairs. 2014; 2: 74-8.

20. Puspita CG. Paparan debu batubara terhadap gangguan faal paru pada pekerja kontrak bagian coal handling PT. PJB Unit Pembangkit Paiton [skripsi]. Jember: Bagian Kesehatan Lingkungan dan Kesehatan Keselamatan Kerja Fakultas Kesehatan Masyarakat Universitas Jember; 2011.

21. Baharudin S, Roestam AW, Yunus F, Ikhsan M, Kekalih A. Analisis hasil spirometri karyawan PT. X yang terpapar debu di area penambangan dan pemrosesan nikel. Jakarta: Departemen Pilmonologi dan Ilmu ke- dokteran Respirasi Fakulta Kedokteran Universitas Indonesia; 2010.
22. Komendong DJWM, Ratu JAM, Kawatu PAT. Hubungan antara lama paparan dengan kapasitas paru tenaga kerja industri mebel di CV. Sinar Mandiri Kota Bitung. Jurnal Kesmas Universitas Sam Ratulangi. 2012; 1 (1): 5-10.
23. Kurniawidjaja LM. Program perlindungan kesehatan respirasi di tempat kerja manajemen risiko penyakit paru akibat kerja. Jurnal Respirologi Indonesia. 2010; 30 (4); 217-29.
24. PT. Hasnur Riung Sinerga. Profil dan gambaran men power di PT. Hasnur Riung Sinergi Site BRE. Rantau, Kalimantan Selatan: PT Hasnur Riung Sinergi; 2014.
25. Sholihah Q, Ratna S, Laily K. Pajanan debu batubara dan gangguan pernafasan pada pekerja lapangan tambang batubara. Jurnal Kesehatan Lingkungan. 2008; 4 (2): 291-311.

# 17. Number Sense: Berpikir Fleksibel dan Intuisi Tentang Bilangan

Sutarto Hadi
Universitas Lambung Mangkurat Banjarmasin

**ABSTRAK**

Pemahaman anak mengenai bilangan bertujuan untuk menambah dan mengembangkan keterampilan berhitung dengan bilangan sebagai alat dalam kehidupan sehari-hari. Salah satu aspek utamanya adalah menekankan pengembangan kepekaan terhadap bilangan atau dikenal dengan *number sense*. *Number sense* dapat diartikan sebagai berpikir fleksibel dan intuisi tentang bilangan. Untuk menilai sifat *number sense* yang dimiliki seorang individu, kita harus memeriksa fleksibilitas terhadap bilangan yang ditunjukkan oleh individu tersebut. Fleksibilitas ini dapat diamati ketika seseorang melakukan empat komponen *number sense*, yaitu menilai besaran bilangan, komputasi mental, estimasi, dan menilai kerasionalitasan atau kewajaran hasil perhitungan yang diperoleh.

*Kata kunci: bilangan, number sense*

## I. PENDAHULUAN

Apapun kurikulum yang berlaku di dunia pendidikan Indonesia, salah satu aspek dalam pembelajaran matematika pada tingkat seko- lah dasar adalah bilangan. *National Council of Teachers of Mathematics* (NCTM) menekankan bahwa pembelajaran bilangan di tingkat dasar sangat penting untuk mempelajari topik matematika yang lain, yaitu aljabar, geometri, pengukuran, dan statistik (Nursyahidah dkk, 2013). Pemahaman anak mengenai bilangan bertujuan untuk menambah dan mengembangkan keterampilan berhitung dengan bilangan sebagai alat dalam kehidupan sehari- hari. Biasanya guru sering terburu-

buru dalam membekali anak menggunakan algoritma tulis. Hal ini dapat menyebabkan anak-anak berhenti menggunakan strategi berpikir intuitif mereka dan membabi buta mengikuti langkah-langkah algoritma (Rogers, 2009; Purnomo, 2013).

Pentingnya mengembangkan pema- haman tentang konsep bilangan telah lama disadari. Salah satu aspek utamanya adalah menekankan pengembangan kepekaan terhadap bilangan atau dikenal dengan *number sense*. Mengembangkan *number sense* adalah tujuan umum pembelajaran matematika dari Taman Kanak-kanak (TK) sampai sekolah menengah. *Number sense* dapat diartikan sebagai berpikir fleksibel dan intuisi tentang bilangan. Agar siswa mengembangkan pemahaman yang mendalam terhadap banyak konsep matematika, sangat diperlukan kemampuan berpikir fleksibel dan lancar terhadap bilangan. Kemampuan ini lebih daripada mampu menulis bilangan, membilang benda-benda, mengingat fakta-fakta, dan mengikuti langkah-langkah untuk menyelesaikan masa- lah tentang bilangan. Ketika siswa belajar fakta-fakta, mereka mampu mengem-bangkan pemikiran matematika mereka untuk perhitungan bilangan yang lebih besar dan lebih rumit. Fakta-fakta tidak harus diingat: siswa harus memahami akibat dari operasi- operasi yang berbeda (+, - , x, ÷) pada bilangan-bilangan.

## II. APA ITU NUMBER SENCE

Tobias Danzig (1967) memperkenal- kan istilah "*number sense*" pada tahun 1956, untuk menjelaskan kemampuan seseorang untuk mengetahui adanya perubahan pada suatu kumpulan, tanpa sepengetahuan orang tersebut, ketika sebuah obyek telah ditambahkan atau diambil dari kumpulan tersebut. Kita memiliki *number sense* karena bilangan memiliki makna bagi kita, seperti kata-kata dan juga irama musik. Sebagaimana kita belajar bahasa, kita terlahir sudah memiliki *number sense*, atau dalam tingkatan yang paling rendah, kita memiliki kemampuan menguasai bilangan pada usia yang masih sangat muda, walaupun tanpa upaya. (Sousa, 2008).

*Number sense* dideskripsikan sebagai pemahaman umum seseorang tentang bilangan dan operasinya bersama dengan kemampuan dan keinginan untuk mengguna- kan pemahaman ini secara fleksibel untuk membuat penilaian matematika dan untuk mengembangkan strategi yang bermanfaat untuk menguasai bilangan dan operasinya (McIntosh, Reys & Reys, 1993; Beswick dkk, 2004: 2).

Perhatikan jawaban dari tiga siswa TK ketika ditanya pertanyaan berikut dari *Number Knowledge Test* (Griffin & Case, 1997; Griffin, 2004: 173): "*Yang mana yang lebih besar: tujuh atau sembilan?*"

Budi menjawab dengan cepat, "*Sembilan*". Ketika ditanya bagaimana dia mengetahuinya, dia berkata, "*Baiklah, begini, 'tujuh' (berhenti sejenak) 'delapan', 'sembi- lan'* (menunjukkan dua jarinya ketika menga- takan dua bilangan yang terakhir). *Itu berarti bahwa sembilan itu dua lebihnya daripada tujuh. Jadi, sembilan lebih besar.*"

Ani berkata dengan ragu, "*Sembilan?*" ketika ditanya bagaimana dia mengetahuinya, dia berkata, "*Karena sembilan adalah bilangan yang besar*." Laila terlihat benar-benar bingung, seolah-olah pertanyaan tersebut bukan hal yang masuk akal, dan berkata, "*Saya tidak tahu.*"

Guru akan segera menyadari bahwa jawaban Budi menunjukkan *number sense* yang bagus untuk tingkat usianya dan jawaban Ani menunjukkan *number sense* yang kurang bagus. Penelitian *Number Knowledge Test* menunjukkan bahwa anak usia 5 tahun seperti Budi mengetahui:

1, bilangan menunjukkan kuantitas dan oleh karena itu, bilangan itu sendiri mempu-nyai besaran;
2. kata "lebih besar" atau "lebih" sesuai untuk konteks ini;
3. bilangan 7 dan 9, seperti setiap bilangan lain dari 1 sampai 10 menempati posisi yang tetap pada urutan membilang;
4. tujuh muncul sebelum 9 ketika kamu menghitung maju;
5. bilangan yang muncul kemudian dalam urutan – yaitu yang lebih tinggi – menunjukkan kuantitas yang lebih besar dan oleh karena itu, 9 lebih besar (atau lebih) daripada 7.

Budi memberikan bukti dari komponen tambahan untuk number sense dalam penjelasan yang dia berikan atas jawabannya. Dengan menggunakan strategi *Counting-on* untuk menunjukkan bahwa 9 muncul setelah dua bilangan dari 7 dan dengan menunjukkan itu berarti bahwa "sembilan adalah dua lebihnya daripada tujuh", Budi menunjukkan bahwa dia juga mengetahui bahwa menghitung maju berkorespondensi dengan tepat kepada peningkatan Sowder, 1994; Pilmer, 2008: 4). Diharapkan mereka mampu untuk mencapai ini ketika membandingkan bilangan dengan representasi yang berbeda, seperti bilangan cacah, desimal, pecahan, dan persen.

Contoh:

1. Urutkanlah 0,4; $\frac{1}{5}$; $\frac{8}{7}$; 0,09.
2. Apakah $\frac{5}{8}$ atau $\frac{7}{12}$ yang lebih dekat dengan 0,5?
3. Tentukan pecahan yang terletak diantara $\frac{4}{9}$ dan $\frac{5}{9}$.

Komputasi mental adalah proses menghitung jawaban numerik yang tepat tanpa bantuan alat hitung eksternal. Persepsi siswa mengenai apa makna menghitung secara mental berbeda-beda. Beberapa siswa percaya bahwa kita hanya menggunakan komputasi mental pada algoritma yang telah ditentukan. Perhatikan contoh berikut.

| Siswa 1: algoritma standar yang dilakukan secara mental | Siswa 2: strategi berpikir |
|---|---|
| $\begin{array}{r} {\scriptstyle 1\phantom{,0}} \\ 6{,}4 \\ 1{,}9 \; + \\ \hline 8{,}3 \end{array}$ | $\begin{aligned} 6{,}4 + 1{,}9 &= 6{,}4 + 2 - 0{,} \\ &= 8{,}4 - 0{,}1 \\ &= 8{,}3 \end{aligned}$ |

Pemahaman ini, mungkin lebih daripada yang telah disebutkan di atas, memungkinkan anak- anak untuk menggunakan perhitungan bilangan saja, tanpa perlu untuk benda real, untuk menyelesaikan masalah kuantitatif yang meliputi penggabungan dua himpunan. Dengan demikian, dia mengubah matematika dari sesuatu yang hanya dapat dilakukan di luar kepalanya (contohnya dengan mema- nipulasi benda nyata) ke sesuatu yang dapat dilakukan di dalam kepala mereka, dan di bawah kendali mereka sendiri.

## III. KOMPONEN UTAMA *NUMBER SENSE*

Jika ada yang mencoba untuk menilai sifat number sense yang dimiliki seorang individu, kita harus memeriksa fleksibilitas terhadap bilangan yang ditunjukkan olehindividu tersebut. Fleksiblitas ini dapat Siswa 1: algoritma standar yang dilakukan secara mental diamati ketika siswa melakukan empat

komponen number sense, yaitu menilai besaran bilangan, komputasi mental, estimasi, dan menilai kerasionalitasan atau kewajaran hasil perhitungan yang diperoleh (Markovits & Sowder, 1994; McIntosh, Reys, Reys, & Hope, 1997, Pilmer, 2008: 4).

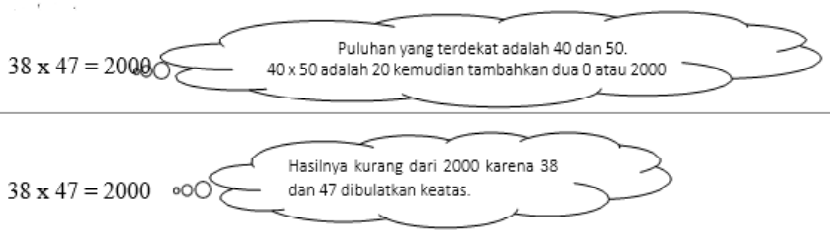
Memahami besaran bilangan maksud- nya bahwa individu harus mampu memban- dingkan bilangan sehingga mereka dapat mengurutkan bilangan, mengenali yang mana dari dua buah bilangan yang lebih dekat dengan bilangan yang ketiga, dan untuk mengidentifikasi bilangan diantara dua bilangan yang diberikan (Markovits &

Komputasi mental dapat memuat algoritma tetapi strategi alternatif seharusnya juga didukung seperti yang ditunjukkan oleh siswa 2 pada contoh tersebut.

Estimasi dapat dibedakan menjadi tiga kategori, yaitu *numerosity*, pengukuran, dan estimasi komputasi (Hason & Hogan, 2000; Pilmer, 2008: 5). *Numerosity* mengacu kepada kemampuan seseorang untuk memperkirakan jumlah benda yang ada. Siswa dapat ditugaskan untuk memperkirakan berapa banyak pensil yang telah ditebarkan di lantai. Pengukuran mengacu pada kemampuan seseorang untuk memperkirakan berat, panjang, atau volume suatu benda, atau waktu yang diperlukan untuk menyelesaikan suatu tugas. Estimasi komputasi mengacu pada kemampuan seseorang untuk memperkirakan jawaban dari perhitungan bilangan.

Contoh:

Pertanyaan : urutkan dari yang paling kecil ke yang paling besar 0,53; $\frac{14}{13}$; $\frac{5}{12}$;

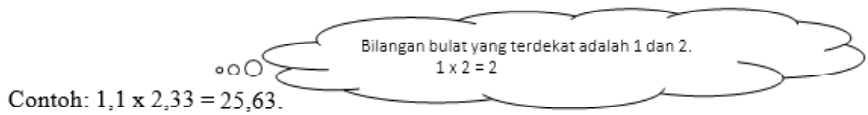


Menilai kewajaran hasil maksudnya bahwa siswa harus memeriksa jawaban yang mereka peroleh dengan atau tanpa teknologi dan menentukan apakah jawaban tersebut sesuai dengan pertanyaan dan konteks yang diberikan.

Hasil : 0,993.

: 31% tidak mampu mengurutkan bilangan-bilangan tersebut dengan benar.

Pertanyaan : apakah hasil dari 264 ÷ 0,79 lebih dari, sama dengan, atau kurang dari 264.




Berikut ini adalah beberapa pertanya- an dan jawaban mengenai *number sense*. Pertanyaan ini diberikan kepada 49 calon guru sekolah dasar dalam penelitian yang dilakukan oleh Markovits (1989; Pilmer, 2008: 9).

Pertanyaan : tinggi anak laki-laki yang berusia 10 tahun adalah 5 kaki. Berapa kira-kira tinggi anak tersebut ketika dia berusia 20 tahun?

Hasil : 13% menjawab 10 kaki (jawaban yang tidak masuk akal)
Pertanyaan : ketika kamu mengalikan 15,24 dan 4,5, jawabannya adalah 6858, tetapi koma desimalnya tidak ada. Letakkan koma desimal pada posisi yang tepat.

Hasil : 79% menjawab bahwa koma desimal terletak setelah 6, yaitu 6,858. Padahal jawaban yang benar adalah 68,58

Hasil : 49% menjawab salah dengan mengatakan hasil pembagiannya kurang dari 264. Mereka menganggap bahwa pembagian selalu membuat bilangan menja- di lebih kecil.

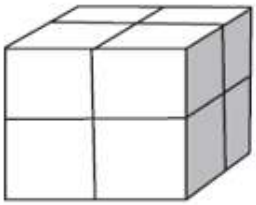
Hasil tersebut menunjukkan bahwa sebagian besar calon guru ini memiliki kesulitan dalam mengestimasi, mental komputasi, menilai besaran bilangan, dan menilai kewajaran jawaban, yang merupakan komponen dari number sense.

## IV. BAGAIMANA MENGAJARKAN*NUMBER SENSE*?

Siswa harus diberikan kesempatan untuk meningkatkan kepekaan mereka terhadap bilangan. Perbedaan dapat muncul dalam masing-masing kelompok siswa dan guru mungkin menemukannya di dalam kelas pada situasi

yang sama. Perhatikan contoh berikut (Treffers, 2001: 39).

Siswa duduk melingkar di dalam kelas dan beberapa blok-blok mainan disusun dengan susunan yang berbeda-beda di tengah kelas. Kemudian siswa memutuskan berapa banyak blok ("ruangan") pada setiap susunan ("gedung") tersebut. Jawaban yang muncul dapat bermacam-macam, khususnya untuk "gedung" yang lebih besar.



Untuk "gedung" yang ditunjukkan seperti diatas, jawaban yang diberikan siswa adalah lima, tujuh, delapan, duabelas, limabelas, dan bahkan enambelas dan tujuhbelas.

Guru: "Baiklah, bukankah ini aneh, ada banyak sekali jawaban yang berbeda?"

Untuk beberapa anak, hal ini bukan sesuatu yang aneh. Bagi mereka, hal ini biasa terjadi ketika membilang – seperti suatu permainan dimana kamu kadang-kadang memberikan lima dan kadang-kadang memperoleh delapan, dan hal ini sungguh bukan masalah. Tetapi anak-anak lain berpikir berbeda. Fiona maju ke depan dan menunjukkan bagaimana dia menghitung.

Dia memulai dari alasnya dan menghitung semua permukaan yang dapat dilihatnya: "Satu, dua, tiga, empat, …" dan berakhir pada bagian atas gedungnya dengan hitungan limabelas.

Siswa lain: "itu seharusnya lebih sedikit." Dia menghitung dua kali." "Kamu jangan menghitung seperti itu!"

Kemudian Rico maju ke depan. Dia menghitung blok dengan benar dari atas ke bawah: "Satu, dua, tiga, empat, …"

Dia menghitung permukaan blok yang terletak pada lapisan terbawah: "Lima, enam, tujuh, delapan, sembilan, … duabelas." Saat ia menghitung suaranya terdengar tidak yakin dan ketika dia selesai dia langsung mengatakan: "Hei, ini aneh. Ibu saya mengatakan bahwa empat dan empat adalah delapan, dan sekarang saya memperolehnya duabelas!"

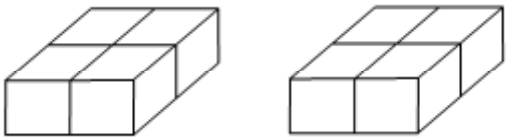
Siswa yang lain bergabung dalam diskusi. Ketika Robert mendapat giliran, dia bertanya: "bolehkah saya memisahkan bloknya?" dia memisahkan susunan blok tersebut dan menghitung blok tersebut satu per satu sementara anak-anak yang lain juga ikut menghitung bersamanya.

Semua siswa sekarang mengetahui bahwa memang ada delapan blok. Ketika bloknya disusun kembali, guru memberikan pertanyaan terakhir: bagaimana kamu melihat bahwa bloknya adalah empat dan empat, Rico?"

Rico: "Baiklah, ini empat (dia memisahkan empat blok yang berada di atas) dan ini juga."

Blok dihitung kembali dan memang benar ada delapan blok. Empat dan empat adalah delapan.

Robert menghitung dengan lebih teratur dengan memisahkan sementara



blok- blok tersebut. Rico mampu menghitung langsung dan melakukan kesalahan ketika menghitung di depan kelas: empat dan empat adalah delapan. Perhatikanlah bahwa anak- anak menggunakan pendekatan yang berbeda- beda. Dengan menggunakan pendekatan anak-anak yang berbeda dan kemudian mendiskusikan di kelas, kekayaan daripengajaran dapat muncul dengan sendirinya. Terlebih lagi, anak-anak telah mampu belajar menggunakan pendekatan dari temannya yang lain. Mereka juga menjadi lebih sadar akan pentingnya membilang dengan teratur dengan cara yang sederhana.

Ada 5 prinsip pengajaran yang dapat digunakan untuk membantu siswa mening- katkan kepekaan mereka terhadap bilangan (Griffin, 2004: 175).

1. Membangun pemahaman yang sudah dimiliki anak-anak

Setiap ide baru yang disampaikan kepada anak-anak harus berhubungan dengan pengetahuan mereka yang sudah ada sehingga akan masuk akal bagi mereka. Anak-anak juga harus diizinkan untuk menggunakan pengetahuan yang telah mereka miliki untuk membangun pengetahuan baru yang berada dalam jangkauan mereka. Untuk itu, guru memerlukan: (a) cara untuk menilai penge-

tahuan yang telah dimiliki anak-anak, dan (b) kegiatan yang multi-level sehingga anak-anak dengan pengetahuan awal yang berbeda dapat memperoleh manfaat.

2. Mengikuti peningkatan perkembangan alami ketika memilih pengetahuan baru yang diajarkan.

Pada usia 4 tahun, sebagian besar anak-anak telah membangun dua jaringan pengetahuan-pengetahuan tentang membilang dan tentang kuantitas – yang memberikan dasar yang tahap perkembangan selanjutnya. Anak-anak TK mampu mengintegrasikan jaringan pengetahuan ini dan membangun pemahaman konsep. Anatar usia 6-7 tahun, anak-anak menghubungkan jaringan penge- tahuan terintegrasi ini ke dunia simbol formal, dan pada usia 8 atau 9 tahun, sebagian besar siswa mampu mengembangkan jaringan pengetahuan ini untuk memahami bilangan dua-digit dan sistem basis 10. Program matematika yang menyediakan kesempatan untuk anak-anak untuk menggunakan pengetahuan yang mereka miliki untuk membangun pengetahuan baru adalah langkah selanjutnya yang alami, yang memberikan kesempatan terbaik membantu anak-anak membuat peningkatan maksimum pada pembelajaran dan perkembangan matematika mereka.

3. Mengajarkan kelancaran komputasi sekaligus pemahaman konsep.

Karena kelancaran komputasi dan pemahaman konsep berjalan seiring perkem- bangan matematika siswa, kesempatan untuk memperoleh kelancaran komputasi juga pemahaman konsep diberikan perhatian yang khusus. Anak-anak diberikan kesempatan yang konkret untuk mengalamitransformasi kuantitas yang sederhana dan menemukan bagaimana membilang dapat digunakan untuk memprediksi dan menjelaskan perbedaan dalam jumlah.

4. Menyediakan banyak kesempatan eks- plorasi langsung, pemecahan masalah, dan komunikasi.

Memberikan kesempatan kepada siswa untuk mengambil gilirannya pada suatu kegiatan pembelajaran untuk tampil secara individu memberikan kesempatan kepada guru untu menilai masing-masing kemampu- an siswa dan memberikan kesempatan kepada siswa untuk belajar dari siswa lainnya.

5. Menujukkan siswa cara-cara bilangan direpresentasikan dalam kehidupan sehari-hari.

Bilangan direpresentasikan dalam lima cara, yaitu sebagai sekelompok benda, pola himpunan-titik, posisi pada garis, posisi pada timbangan, dan titik pada suatu tombol. Anak-anak yang terbiasa dengan representasi yang bermacam-macam ini dan bahasa yang digunakan untuk berbicara mengenai bilangan tersebut memerlukan waktu yang lebih sedikit untuk memahami permasalahan bilangan.

## V. KESIMPULAN

*Number sense* adalah prasyarat untuk semua perkembangan komputasi. *Number sense* muncul sebagai hasil dari belajar daripada melalui pengajaran langsung. Guru dapat mengembangkan *number sense* dengan menyediakan tugas-tugas matematika yang kaya dan mendorong siswa untuk membuat hubungan dengan pengalaman pribadi mereka dan pembelajaran mereka sebelumnya.

## DAFTAR PUSTAKA


Beswick, K., Muir, T., McIntosh, A. (2004). Developing an Instrument to Assess the Number Sense of Young Children. Paper Presented at the AARE Annual Conference, Melbourne.

Danzig, T. (1967). *Number: The language of science*. New York: Free Press.

Griffin, S. (2004). Building Number Sense, with Number Worlds: A Mathematics Program for Young Children. *Early Chilhood Research Quarterly,* 173-180.

Nursyahidah, F., Ilma, R. I. P., Somakim (2013). Supporting First Grade Students' Understanding of Addition up to 20 Using Traditional Game. *Journal on Mathematics Education (IndoMS- JME), July 2013, Volume 4. No. 2*, 212-223.

Pilmer, C. D. (2008). *Number Sense. Nova Scotia School for Adult Learning*. Department of Labour and Workforce Development.

Purnomo, Y. W. (2013). Komputasi Mental untuk Mendukung Lancar Berhitung Operasi Penjumlahan dan Pengurangan pada Siswa Sekolah Dasar. *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika, Jurusan Pendidikan Matematika FMIPA UNY, ISBN: 978-979-16353-9-4*, MP - 657-662.

Sousa, D.A. (2008). *How the brain learns mathematics*. Thousand Oaks, CA: Corwin Press.

van den Heuvel-Panhuizen, M. 2001. *Children Learn Mathematics: A Learning-Teaching Trajectory with Intermediate Attainment Targets for Calculation with Whole Numbers in Primary School*. The Netherlands: Freudenthal Institute, Utrecht University.

# I8. Pemahaman Konsep Matematika Siswa SMP Melalui Penerapan Model Pembelajaran Kooperatif Tipe Memeriksa Berpasangan (*Pair Checks*)

Sutarto Hadi, Maidatina Umi Kasum
Universitas Lambung Mangkurat Banjarmasin

**ABSTRAK**

Matematika merupakan pelajaran yang memerlukan pemusatan pemikiran untuk mengingat dan mengenal kembali materi yang dipelajari. Namun pada kenyataannya, salah satu masalah pokok dalam pembelajaran matematika adalah masih rendahnya pemahaman konsep matematika. Hal ini disebabkan karena sejauh ini paradigma pembelajaran matematika di sekolah masih didominasi oleh paradigma pembelajaran konvensional. Salah satu cara mengatasi hal ini adalah dengan menerapkan model pembelajaran kooperatif tipe Memeriksa Berpasangan (Pair Checks), karena model ini memberikan banyak kesempatan kepada siswa untuk berinteraksi dengan pasangannya. Penelitian ini bertujuan untuk mengetahui (1) pemahaman konsep matematika siswa SMPN 1 Martapura dengan menerapkan model pembelajaran kooperatif tipe Pair Checks, (2) pemahaman konsep matematika siswa SMPN 1 Martapura dengan menerapkan pembelajaran konvensional, dan (3) perbedaan rata-rata pemahaman konsep matematika yang signifikan antara siswa yang menerapkan model pembelajaran kooperatif tipe Pair Checks dan siswa yang menerapkan pembelajaran konvensional. Penelitian ini menggunakan metode quasi experiment, dengan populasi seluruh siswa kelas VIII SMP Negeri 1 Martapura. Pengambilan sampel menggunakan teknik purposive sampling dan random sampling. Teknik pengumpulan data menggunakan wawancara, tes, dan

dokumentasi. Data yang diperoleh dianalisis dengan statistik deskriptif dan statistik inferensial. Hasil penelitian menunjukkan bahwa pemahaman konsep matematika siswa SMPN 1 Martapura dengan menerapkan model pembelajaran kooperatif tipe Pair Checks berada pada kualifikasi amat baik, pemahaman konsep matematika siswa SMPN 1 Martapura dengan menerapkan pembelajaran konvensional berada pada kualifikasi baik, dan terdapat perbedaan rata-rata pemahaman konsep matematika yang signifikan antara siswa yang menerapkan model pembelajaran kooperatif tipe Pair Checks dan siswa yang menerapkan pembelajaran konvensional.

Kata kunci: model pembelajaran kooperatif tipe Pair Checks, pembelajaran konvensional, pemahaman konsep

## I. PENDAHULUAN

Matematika merupakan pelajaran yang memerlukan pemusatan pemikiran untuk mengingat dan mengenal kembali materi yang dipelajari sehingga siswa harus mampu menguasai konsep materi tersebut. Keberhasilan penguasaan konsep awal matematika pada siswa menjadi pembuka jalan dalam penyampaian konsep-konsep matematika pada materi selanjutnya. Dalam Permendiknas RI No 22 Tahun 2006, salah satu tujuan pembelajaran matematika pada pendidikan menengah adalah agar siswa memahami konsep matematika, menjelaskan keterkaitan antar konsep dan mengaplikasi- kan konsep atau algoritma, secara luwes, akurat, efisien, dan tepat dalam pemecahan masalah.

Sutarto Hadi, Maidatina Umi Kasum, Konsep Matematika Siswa SMP Melalui Pemahaman konsep matematika merupakan landasan penting untuk berpikir dalam menyelesaikan permasalahan matematika maupun permasalahan sehari- hari. Dengan pemahaman konsep matematika yang baik, siswa akan mudah mengingat, menggunakan, dan menyusun kembali suatu konsep yang telah dipelajari serta dapat menyelesaikan berbagai variasi soal matematika. Namun pada kenyataannya, salah satu masalah pokok dalam pembelajaran matematika adalah masih rendahnya daya serap dan pemahaman siswa terhadap konsep matematika. Menurut Fathani dan Masykur (2007), hal ini disebabkan karena sejauh ini paradigma pembelajaran matematika di sekolah masih didominasi oleh paradigma pembelajaran konvensional, dimana guru ceramah, menggurui, dan otoritas tertinggi terletak pada guru.

Berdasarkan hasil wawancara dengan salah satu guru matematika di SMPN 1 Martapura menunjukkan bahwa kemampuan pemahaman siswa

terhadap konsep-konsep matematika masih tergolong rendah. Hal ini dapat dilihat berdasarkan analisis kerja UTS siswa kelas VIII SMPN 1 Martapura dan kurang dari 50 persen siswa belum memenuhi Kriteria Ketuntasan Minimal (KKM). Kelemahan pemahaman konsep dalam hal ini siswa belum bisa mengembangkan syarat perlu atau syarat cukup suatu konsep dengan tepat, serta keliru dalam memahami soal sehingga tidak bisa mengaplikasikan konsep atau algoritma dalam pemecahan masalah. Selain itu, ketika berdiskusi kelompok hanya siswa tertentu saja yang berpartisipasi lebih aktif, sementara siswa yang lain enggan berusaha untuk mengemukakan pendapatnya.

Rendahnya pemahaman konsep matematika siswa dipengaruhi oleh beberapa hal, salah satunya adalah model pem- belajaran yang digunakan guru. Kurang tepatnya pemilihan model pembelajaran oleh guru akan mempengaruhi proses belajar siswa. Oleh karena itu, perlu pembelajaran yang dapat mempermudah siswa dalam memahami konsep matematika, serta melibatkan semua siswa agar menjadi lebih aktif dan lebih berkonsentrasi dalam proses pembelajaran.

Model pembelajaran kooperatif tipe Memeriksa Berpasangan (Pair Checks) merupakan salah satu cara untuk mening- katkan pemahaman konsep matematika siswa dan membantu siswa yang pasif dalam kegiatan kelompok. Pada model ini siswa dibagi dalam pasangan-pasangan dan satu pasangan terdiri dari dua orang siswa. Karena hanya terdiri dari dua orang, pasangan ini akan belajar dengan lebih aktif dalam memecahkan masalah sehingga siswa menjadi lebih paham. Pembagian kelompok siswa secara berpasangan menunjukkan pencapaian yang jauh lebih besar dalam bidang ilmu pengetahuan daripada kelompok yang terdiri atas empat atau lima orang (Slavin, 2010). Model pembelajaran kooperatif tipe Pair Checks bertujuan untuk mendalami atau melatih materi yang telah dipelajarinya. Dalam model ini siswa bekerja berpasangan dan menerapkan susunan pengecekan berpasangan sehingga di-harapkan dapat meningkatkan pemahaman konsep dan partisipasi siswa untuk menyumbangkan pemikiran mereka. Model ini juga memberikan banyak kesempatan kepada siswa untuk berinteraksi menyampaikan ide-idenya, merefleksikan gagasan yang diberikan temannya dan berdiskusi menyamakan ide dengan pasangannya.

Adapun tujuan dalam penelitian iniyaitu:

(1) untuk mengetahui pemahaman konsep matematika siswa SMP Negeri 1 Martapura dengan menerapkan model pembelajaran kooperatif tipe Pair Checks,

(2) mengetahui pemahaman konsep matematika siswa SMP Negeri 1 Martapura dengan menerapkan pembelajarankonvensional, dan

(3) mengetahui perbedaan rata-rata pemahaman konsep matematika yang signifikan antara siswa yang menerapkan model pembelajaran kooperatif tipe Pair Checks dan siswa yang menerapkan pembelajaran konvensional.

Menurut Huda (2013), model pembelajaran kooperatif tipe Pair Checks ini menerapkan pembelajaran kooperatif yang menuntut kemandirian dan kemampuan siswa dalam menyelesaikan persoalan. Model ini juga melatih tanggung jawab sosial siswa, kerjasama, dan kemampuan memberi penilaian. Langkah-langkah rinci penerapan model pembelajaran kooperatif tipe Pair Chekcs adalah sebagai berikut:

(1) Guru menjelaskan konsep.

(2) Siswa dibagi ke dalam beberapa tim. Setiap tim terdiri dari 4 orang. Dalam satu tim ada 2 pasangan. Setiap pasangan dalam satu tim dibebani masing-masing satu peran yang berbeda yaitu pelatih dan rekan.

(3) Guru membagikan soal kepada rekan.

(4) Rekan menjawab soal, dan pelatih bertugas mengecek jawabannya. Rekan yang menjawab satu soal dengan benar berhak mendapat satu kupon dari pelatih.

(5) Pelatih dan rekan saling bertukar peran, pelatih menjadi rekan, dan rekan menjadi pelatih.

(6) Guru membagikan soal kepada rekan.

(7) Rekan menjawab soal, dan pelatih bertugas mengecek jawabannya. Rekan yang menjawab satu soal dengan benar berhak mendapat satu kupon dari pelatih.

(8) Setiap pasangan kembali ke tim awal dan mencocokkan jawaban satu sama lain.

(9) Guru membimbing dan memberikan arahan atas jawaban dari berbagai soal.

(10) Setiap tim mengecek jawabannya.

(11)Tim yang paling banyak mendapat kupon diberi hadiah oleh guru.

Model pembelajaran kooperatif tipe Pair Checks mempunyai kelebihan dan kekurangan. Menurut Huda (2013) beberapa kelebihan dan kekurangan dari

model pembelajaran kooperatif tipe Pair Checks sebagai berikut:

Kelebihan model pembelajaran kooperatif tipe Pair Checks bila diterapkan pada model pembelajaran kooperatif, yaitu:

(1) Meningkatkan kerjasama antar siswa.

(2) Adanya tutor sebaya.

(3) Meningkatkan pemahaman atas konsep dan/atau proses pembelajaran.

(4) Melatih siswa berkomunikasi dengan baik dengan teman sebangkunya.

Kekurangan yang dapat muncul dari penerapan model pembelajaran kooperatif tipe Pair Checks ini pada model pembelajaran kooperatif di kelas:

(1) Membutuhkan waktu yang benar-benar memadai.

(2) Membutuhkan kesiapan siswa untuk menjadi pelatih dan partner yang jujur dan memahami soal dengan baik.

Berbeda dengan model pembelajaran kooperatif tipe Pair Checks, pembelajaran konvensional merupakan pembelajaran yang biasa dilakukan oleh guru dalam proses belajar mengajar di kelas. Pada pola pembelajaran konvensional, kegiatan proses belajar mengajar lebih sering diarahkan pada aliran informasi dari guru ke siswa. Menurut Kunandar (2011) pembelajaran konvensional sifatnya berpusat pada guru sehingga pelaksanaannya kurang memperhatikan keseluruhan situasi belajar dan pada umumnya tidak memperhatikan ketuntasan belajar khususnya ketuntasan siswa secara individu.

Kegiatan mengajar dalam pembelajaran konvensional cenderung diarahkan pada aliran informasi dari guru ke siswa, serta penggunaan metode ceramah terlihat sangat dominan. Pola mengajar kelihatan baku, yakni menjelaskan sambil menulis di papan tulis serta diselingi tanya jawab, sementara itu siswa memperhatikan penjelasan guru sambil mencatat di buku tulis. Siswa dipandang sebagai individu pasif yang tugasnya hanya mendengarkan, mencatat, dan menghapal. Pembelajaran konvensional berpusat pada gurudan tidak terjadi interaksi yang baik antara siswa dengan siswa.

Menurut Sanjaya (Harja, 2012) pemahaman konsep adalah kemampuan siswa yang berupa penguasaan sejumlah materi pelajaran, dimana siswa tidak sekedar mengetahui atau mengingat sejumlah konsep yang dipelajari, tetapi mampu mengungkap- kan kembali dalam bentuk lain yang mudah dimengerti, memberikan interprestasi data dan mampu mengaplikasikan konsep yang sesuai dengan struktur kognitif yang dimilikinya.

Skemp (Afgani, 2011) membedakan dua jenis pemahaman konsep, yakni pemahaman instrumental dan pemahaman relasional. Pemahaman instrumental diartikan sebagai pemahaman atas konsep yang saling terpisah dan hanya hafal rumus perhitungan sederhana. Dalam hal ini, seseorang hanya memahami urutan pengerjaan algoritma. Sebaliknya, pemaham- an relasional memuat skema dan struktur yang dapat digunakan pada penyelesaian masalah yang lebih luas dan bermakna. Menurut Van De Walle (2008), faktor-faktor yang mempengaruhi pemahaman siswa tehadap konsep matematika adalah : (1) berpikir reflektif siswa, (2) interaksi, dan (3) penggunaan model atau alat-alat untuk belajar (peraga, penggunaan simbol, komputer, menggambar, dan bahasa lisan).

Indikator pencapaian pemahaman konsep menurut Peraturan Dirjen Dikdasmen Nomor 506/C/Kep/PP/2004 adalah (1) menyatakan ulang sebuah konsep, (2) mengklasifikasi objek menurut sifat-sifat tertentu sesuai dengan konsepnya, (3) memberi contoh dan bukan contoh dari konsep, (4) menyajikan konsep dalam berbagai bentuk representasi matematis, (5) mengembangkan syarat perlu atau syarat cukup dari suatu konsep, (6) menggunakan, memanfaatkan dan memilih prosedur atau operasi tertentu, dan (7) mengaplikasikan konsep atau algoritma ke pemecahan masalah.

## II. METODE

Penelitian ini dilaksanakan dengan metode quasi experiment dengan static group design atau non-equivalent posttest-only design (Seniati dkk, 2011), dimana hasil tes akhir kelas eksperimen dan kelas kontrol dibandingkan. Populasi dalam penelitian ini adalah siswa kelas VIII SMP Negeri 1 Martapura tahun pelajaran 2013/2014 sebanyak 237 orang, yang terdiri dari 8 kelas. Sedangkan sampel penelitian adalah siswa kelas VIII A dan VIII E SMP Negeri 1 Martapura. Teknik sampel yang digunakan pada penelitian ini adalah purposive samplingdan Random Sampling.

Teknik pengumpulan data yang digunakan dalam penelitian ini adalah wawancara, tes, dan dokumentasi. Wawancara digunakan berkaitan dengan studi pendahuluan dalam mengidentifikasi permasalahan kemampuan pemahaman konsep matematika siswa, permasalahan siswa saat kegiatan belajar mengajar berlangsung, serta model pembelajaran yang selama ini digunakan oleh guru. Bentuk tes yang digunakan berupa tes essay sebanyak 7 soal untuk tes evaluasi akhir. Sedangkan dokumentasi dilakukan untuk memperoleh data pelaksanaan proses pembelajaran di dalam kelas dan untuk

pengumpulan data yang berkaitan dengan sekolah yang menjadi tempat penelitian.

Data yang diperoleh merupakan nilai kognitif hasil pemahaman konsep matematika yang berupa nilai kemampuan awal dan nilai evaluasi akhir program pembelajaran yang dianalisis dengan menggunakan statistik deskriptif dan statistik inferensial.

Kualifikasi hasil pemahaman konsep yang dicapai oleh siswa dapat diketahui melalui nilai rata-rata yang dirumuskan dengan :

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$ (Sudjana, 2005)

Keterangan :
$\bar{x}$ = nilai rata-rata (mean)
$\sum f_i x_i$ = jumlah hasil perkalian antara masing-masing data dengan frekuensinya
$\sum f_i$ = jumlah data atau sampel

Selanjutnya nilai rata-rata pemahaman konsep tersebut diinterpretasikan dengan menggunakan tabel 1 berikut ini:

Tabel 1 Interpretasi Nilai Rata-Rata

| No. | Nilai | Kriteria |
|---|---|---|
| 1. | ≥ 95,00 | Istimewa |
| 2. | 80,00-94,99 | Amat baik |
| 3. | 65,00-79,99 | Baik |
| 4. | 55,00-64,99 | Cukup |
| 5. | 40,00-54,99 | Kurang |
| 6. | < 40,00 | Amat kurang |

(Adaptasi dari Dinas Pendidikan Provinsi Kalsel, 2004)

Cara perhitungan tingkat pemahaman konsep matematika yang dicapai oleh siswa pada posttest dapat dirumuskan sebagai berikut :

$$P = \frac{skor\ jawaban\ siswa}{skor\ maksimal} \times 100\%$$

dengan P sebagai persentase skor jawaban siswa.

Selanjutnya kemampuan pemahaman konsep matematika tersebut dapat dikualifikasikan sebagai berikut :

Tabel 2 Kualifikasi Pemahaman Konsep Matematika Siswa

| Persentase (%) | Kualifikasi Pemahaman Konsep |
|---|---|
| 81-100 | Sangat tinggi |
| 61-80,99 | Tinggi |
| 41-60,99 | Cukup |
| 21-40,99 | Rendah |
| 0-20,99 | Sangat rendah |

(adaptasi dari Arikunto, 2013b)

Nilai pemahaman konsep dianalisis menggunakan uji beda, yang mana sebelumnya dilakukan uji pendahuluan berupa uji normalitas dan uji homogenitas. Data yang berdistribusi normal dianalisis menggunakan uji t, sementara itu data yang tidak berdistribusi normal dianalisis menggunakan uji Mann-Whitney.

.

## III. HASIL DAN PEMBAHASAN

Hasil evaluasi pemahaman konsep matematika siswa pada kelas eksperimen ditunjukkan pada tabel 3 berikut yang diukur berdasarkan kualifikasi pemahaman konsep matematika siswa pada tabel 1.

Tabel 3 Distribusi Frekuensi Pemahaman Konsep Matematika Siswa Kelas VIII A (Kelas Eksperimen)

| Nilai | Frekuensi | Persentase(%) | Keterangan |
|---|---|---|---|
| ≥ 95,00 | 4 | 12,90 | Istimewa |
| 80,00-94,99 | 21 | 67,74 | Amat baik |
| 65,00-79,99 | 6 | 19,36 | Baik |
| 55,00-64,99 | 0 | 0,00 | Cukup |
| 40,00-54,99 | 0 | 0,00 | Kurang |
| < 40,00 | 0 | 0,00 | Amat kurang |
| Jumlah | 31 | 100 | |

Berdasarkan tabel 3 diketahui bahwa frekuensi pemahaman konsep matematika siswa pada kelas eksperimen yang tertinggi berada pada kualifikasi amat baik. Rata-rata nilai pemahaman konsep matematika siswa pada kelas eksperimen adalah 85,32% dan termasuk dalam kualifikasi amat baik. Hal ini disebabkan karena dalam pelaksanaan pembelajaran yang menerapkan model pembelajaran kooperatif tipe Pair Checks pada pembelajaran matematika,

kegiatan belajar mengajar berjalan dengan baik sesuai dengan tujuan yang telah direncanakan. Dimana guru dapat lebih banyak melibatkan siswa karena pembelajaran tersebut me- nuntut keaktifan siswa dan berfokus pada kegiatan siswa yang bekerja secara ber- pasangan sesuai dengan perannya masing-masing. Saat proses pembelajaran di kelas eksperimen, siswa belajar dengan lebih leluasa untuk berpendapat serta menggali potensinya. Hal ini dikembangkan melalui pembelajaran kooperatif tipe Pair Checks yang di dalamnya terdapat sintak bertukar peran untuk memecahkan permasalahan serta memeriksa pemecahan masalah tersebut. Keberhasilan penerapan model pembelajaran kooperatif tipe Pair Checks didukung pula oleh beberapa kelebihan yang dimiliki model pembelajaran tersebut yaitu dapat meningkatkan pemahaman konsep matematika siswa karena dalam proses belajar dipandu melalui bantuan tutor sebaya. Sementara hasil evaluasi pemahaman konsep matematika siswa pada kelas kontrol ditunjukkan pada tabel 4 berikut yang diukur berdasarkan pemahaman konsep matematika siswa pada tabel 1.

Tabel 4 Distribusi Frekuensi Pemahaman Konsep Matematika Siswa Kelas VIII E (Kelas Kontrol)

| Nilai | Frekuensi | Persentase(%) | Keterangan |
|---|---|---|---|
| ≥ 95,00 | 0 | 0,00 | Istimewa |
| 80,00-94,99 | 6 | 20 | Amat baik |
| 65,00-79,99 | 20 | 66,67 | Baik |
| 55,00-64,99 | 3 | 10 | Cukup |
| 40,00-54,99 | 1 | 3,33 | Kurang |
| < 40,00 | 0 | 0,00 | Amat kurang |
| Jumlah | 30 | 100 | |

Berdasarkan tabel 4 diketahui bahwa frekuensi pemahaman konsep matematika siswa pada kelas kontrol yang tertinggi berada pada kualifikasi baik. Rata-rata nilai pemahaman konsep matematika siswa pada kelas kontrol adalah 72,25% dan termasuk dalam kualifikasi baik. Hal ini disebabkan karena dalam pelaksanaan pembelajaran kegiatan belajar mengajar menggunakan pembelajaran konvensional berjalan dengan baik sesuai dengan rencana pelaksanaan pembelajaran. Namun, guru lebih banyak menjelaskan sedangkan siswa lebih banyak mendengarkan dan membuat catatan dari penjelasan yang disampaikan guru. Sehing- ga, peran guru dalam pembelajaran lebih banyak dan hanya beberapa orang siswa yang terlihat aktif dalam kegiatan pem- belajaran. Pada saat guru menjelaskan ma- teri, hanya sebagian siswa yang memper- hatikan, ini disebabkan siswa malas dan jenuh dengan model pembelajaran itu saja tanpa

ada variasi dalam pembelajaran tersebut. Peran tutor sebaya juga sangat kurang, sehingga dalam pembelajaran konvensional sangat minim interaksi, terutama interaksi antar siswa. Hal ini meng-akibatkan guru sukar mengetahui sampai dimana siswa telah memahami materi yang disampaikan.

Hasil evaluasi pemahaman konsep matematika siswa untuk tiap indikator pema- haman konsep pada kelas eksperimen dan kelas kontrol ditunjukkan pada tabel 5.

Pemahaman konsep matematika siswa pada kelas eksperimen dan kelas kontrol dapat diketahui bahwa rata-rata dari persentase tiap indikator pemahaman konsep matematika siswa kelas eksperimen lebih tinggi dari pada kelas kontrol, yaitu 81,43% dan berada pada kualifikasi sangat tinggi sedangkan kelas kontrol mencapai 65,51% dan berada pada kualifikasi tinggi. Dilihat dari persentase pencapaian siswa dari tiap indikator pemahaman konsep, ternyata persentase pencapaian semua indikator di kelas eksperimen lebih tinggi dibandingkan kelas kontrol.

Tabel 5 Persentase Pencapaian dari Setiap Indikator Pemahaman Konsep Matematika Siswa Pada Kelas Eksperimen dan Kontrol

| No | Indikator Pemahaman Konsep | Persentase Pencapaian Kelas Eksperimen (%) | Persentase Pencapaian Kelas Kontrol (%) |
|---|---|---|---|
| 1. | Menyatakan ulang sebuah konsep | 93,82 | 84,44 |
| 2. | Mengklasifikasi objek menurut sifat-sifat tertentu sesuai dengan konsepnya | 95,56 | 93,33 |
| 3. | Memberi contoh dan bukan contoh dari konsep | 70,16 | 59,17 |
| 4. | Menyajikan konsep dalam berbagai bentuk representasi matematika | 63,71 | 45,83 |
| 5. | Mengembangkan syarat perlu atau syarat cukup dari suatu konsep | 84,68 | 53,33 |
| 6. | Menggunakan, memanfaatkan dan memilih prosedur atau operasi tertentu | 87,10 | 73,33 |
| 7. | Mengaplikasikan konsep atau algoritma dalam pemecahan masalah | 75,00 | 49,17 |
| | Rata-rata | 81,43 | 65,51 |

Berdasarkan hasil analisis statistik menggunakan uji t dengan tingkat signifikansi 5%, menunjukkan bahwa terdapat perbedaan rata-rata pemahaman konsep matematika yang signifikan antara siswa yang menerap- kan model pembelajaran kooperatif tipe Pair Checks dan siswa yang menerapkan pembelajaran konvensional. Hal ini disebab- kan karena pada model pembelajaran kooperatif tipe Pair Checks siswa memiliki kebebasan dalam berekspresi, mulai dari mengemukakan pendapat kepada guru dan teman, mengerjakan latihan hingga mampu bersosialisasi dalam pasangan dan timnya masing-masing sehingga menimbulkan se- mangat lebih tinggi dalam memperhatikan dan merespon penjelasan guru dibandingkan dengan siswa pada pembelajaran konven- sional. Sejalan dengan pendapat Van De Walle (2008) bahwa interaksi siswa pada model pembelajaran kooperatif tipe Pair Checks dapat mempengaruhi pemahaman konsep matematika siswa karena interaksi yang banyak di dalam kelas tersebut

akan meningkatkan peluang terjadinya berpikir reflektif yang produktif.

## SIMPULAN DAN SARAN

Simpulan

Berdasarkan hasil penelitian yang telah dilakukan dapat diambil beberapa simpulan sebagai berikut:

(1) Pemahaman konsep matematika siswa SMP Negeri 1 Martapura dengan me- nerapkan model pembelajaran koopera- tif tipe Pair Checksberada pada kualifikasi sangat tinggi untuk indikator me- nyatakan ulang sebuah konsep; mengklasifikasi objek menurut sifat-sifat tertentu sesuai dengan konsepnya; mengembangkan syarat perlu atau syarat cukup dari suatu konsep; dan menggunakan, memanfaatkan dan memilih prosedur atau operasi tertentu, sedangkan untuk indikator lainnya berada pada kualifikasi tinggi.

(2) Pemahaman konsep matematika siswa SMP Negeri 1 Martapura dengan menerapkan pembelajaran konvensional berada pada kualifikasi sangat tinggi untuk indikatormenyatakan ulang sebuah konsep dan mengklasifikasi objek menurut sifat-sifat tertentu sesuai dengan konsepnya, kemudian untuk indikator menggunakan, memanfaatkan dan memilih prosedur atau operasi tertentu berada pada kualifikasi tinggi, sedangkan untuk indikator lainnya berada pada kualifikasi cukup.

(3) Terdapat perbedaan rata-rata pemaha-man konsep matematika yang signifikan antara siswa yang menerapkan model pembelajaran kooperatif tipe Pair Checks dan siswa yang menerapkan pembelajaran konvensional.

Saran

Berdasarkan simpulan yang diperoleh dalam peneltian ini, maka disampai- kan beberapa saran yaitu:

(1) Pembelajaran matematika dengan model pembelajaran kooperatif tipe Pair Checksdapat memotivasi siswa untuk lebih aktif sehingga dapat meningkatkan pemahaman konsep matematika siswa dan menjadikannya sebagai motivasi untuk belajar matematika.

(2) Bagi guru matematika dapat menerapkan model pembelajaran kooperatif tipe Pair Checks sebagai alternatif dan variasi dalam pembelajaran matematika untuk meningkatkan pemahaman konsep siswa dan dalam upaya peningkatan kualitas pembelajaran matematika di sekolah.

Penggunaan model pembelajaran kooperatif tipe *Pair Checks* hendaknya memperhatikan waktu pembelajaran, karena dalam penerapannya model pembelajarankooperatif tipe *Pair Checks* membutuhkan waktu yang relatif panjang.

(3) Diharapkan ada penelitian lebih lanjut berkenaan dengan hasil penelitian ini di tempat dan dengan pokok bahasan berbeda, mengingat berbagai keterba- tasan yang ada dalam penelitian ini.

## DAFTAR PUSTAKA


Afgani, D.J. 2011. Analisis Kurikulum Matematika Edisi 1. Universitas Terbuka, Jakarta.

Arikunto, S. 2013b. Manajemen Penelitian. Rineka Cipta, Jakarta.

Depdiknas. 2006. Peraturan Menteri Pendidikan Nasional No. 22 tahun 2006 tentang Standar Isi untuk Satuan Pendidikan Dasar dan Menengah. Jakarta, Depdiknas.

Fhatani, A.H. & M. Masykur.2007 .Mathe- matical Intelligence cara Cerdas Melatih Otak dan Menanggulangi Kesulitan Belajar. Ar-Ruzz Media, Jogjakarta.

Harja. 2012. Pemahaman Konsep Matematis. Prosiding Seminar Nasional FKIP Universitas Sriwijaya, Sriwijaya. Hlm: 3-4.

Huda, M. 2013. Model-model Pengajaran dan Pembelajaran. Pustaka Pelajar, Yogyakarta.

Kunandar. 2011. Guru Profesional Implementasi Kurikulum Tingkat Satuan Pendidikan (KTSP) dan Sukses dalam Sertifikasi Guru. Rajawali Pers, Jakarta.

Seniati, L, dkk. 2011. Psikologi Eksperimen. Indeks, Jakarta.

Slavin, R.E.2010. Cooperative Learning:Applying Contact Theory in Desegrated Schools.Jurnal of Social Issues.Vol.41 Issue 3: 45-62.

Sudjana. 2005. Metoda Statistika. Tarsito, Bandung.

Tim Depdiknas Kalsel. 2004. Pedoman Penyelenggaraan Ujian Akhir Sekolah dan Ujian Akhir Nasional Bagi Sekolah/Madrasah Tahun pelajaran 2013/2014 Provinsi Kalimantan Selatan. Dinas Pendidikan pemerintah provinsi Kalimantan Selatan, Banjarmasin.

Tim Dosen Jurusan Pendidikan MIPA FKIP – Unlam, Banjarmasin. 2012. Petunjuk Penulisan Karya Ilmiah. Jurusan PMIPA FKIP – Unlam, Banjarmasin.

Van de Walle, J. A. 2008. Pengembangan Pengajaran Sekolah Dasar dan Menengah Matematika. Erlangga, Jakarta.

# 19. Bimbingan Pembuatan Proposal PTK Bagi Guru Peserta MGMP Matematika Kota Banjarmasin

Hidayah Ansori, Sutarto Hadi, Rizki Amalia, Maulida Fitri
Pendidikan Matematika, FKIP, Universitas Lambung Mangkurat

**ABSTRAK**

Upaya untuk memperbaiki dan meningkatkan mutu proses belajar mengajar di kelas harus selalu dilakukan. Salah satu upaya tersebut ialah dengan melaksanakan Penelitian Tindakan Kelas (PTK). Oleh karena itu, perlu diadakan pelatihan untuk membimbing guru khususnya peserta MGMP (Musyawarah Guru Mata Pelajaran) Matematika SMA Kota Banjarmasin dalam pembuatan proposal PTK. Tujuan dari pengabdian ini adalah untuk memberikan pemahaman dan mengingat kembali tentang PTK. Subjek dalam pengabdian ini adalah Guru Matematika MGMP Matematika SMA Kota Banjarmasin. Metode yang digunakan yaitu menjelaskan kepada peserta pelatihan mengenai konsep dasar PTK, membimbing peserta membuat draf proposal PTK, mendiskusikan kesulitan dalam pembuatan proposal PTK, membimbing peserta memperbaiki proposal PTK dan menghasilkan proposal PTK yang dapat digunakan untuk penelitian. Kegiatan Pengabdian kepada Masyarakat berupa bimbingan pembuatan proposal PTK untuk guru peserta MGMP Matematika SMA Kotamadya Banjarmasin sudah dilaksanakan dengan lancer. Kegiatan ini sangat mendukung peningkatan kemampuan guru dalam rangka meningkatkan produktivitas pendidikan dengan pembuatan proposal PTK. Guru-guru mulai mengingat dan memahami kembali materi PTK dan menghasilkan proposal PTK.

Kata Kunci: bimbingan; proposal PTK

## I. PENDAHULUAN

Upaya peningkatan mutu pendidikan salah satunya ialah dengan mengoptimalkan kompetensi guru. Guru merupakan komponen utama dan pertama dalam peningkatan mutu pendidikan (Saifulloh, Muhibbin, & Hermanto, 2012). Ditangan gurulah, pembelajaran yang bermutu dan bermakna dihasilkan. Oleh karena itu, untuk menjamin optimalisasi hasil pembelajaran diperlukan guru dengan kualifikasi dan kompetensi yang mampu memenuhi tuntutan tugasnya (Mastuang, Mahtari, Salam, Susilowati, Rizki, & Ramadhan, 2020; Sudibyo, 2013).

Guru banyak mengalami persoalan pembelajaran, baik itu yang berhubungan dengan pemahaman materi, penggunaan metode, media, alat peraga maupun alat evaluasi (Kunandar, 2011). Penelitian yang dilakukan Ni'mah (2017) diperoleh hasil bahwa sebanyak 20 % guru tidak pernah melaksanakan penelitian tindakan kelas dalam setahun, 70 % guru melaksanakan PTK satu kali dalam satu tahun dan hanya 10 % guru yang melaksanakan PTK tiap semesternya. Hal ini dikarenakan banyak problem yang ditemui guru untuk melakukan kegiatan PTK baik itu karena guru tidak memahami teknik dan prosedur penulisan PTK, tidak ada waktu atau sekedar alas an malas, bahkan lebih lanjut PTK dilaksanakan jika ada kenaikan pangkat bagi guru Pegawai Negeri Sipil. Permasalahan yang terjadi pada guru-guru MGMP Matematika SMA Kota Banjarmasin yaitu mereka perlu pengetahuan tentang model-model pembelajaran yang terbaru serta mengingat kembali tentang PTK melalui penjelasan ahli, fasilliatator untuk berdikusi dalam PTK dan motivasi untuk membuat penelitian tentang PTK.

Upaya yang dapat dilakukan guru untuk memperbaiki dan meningkatkan mutu pembelajaran di kelas ialah dengan melaksanakan Penelitian Tindakan Kelas (PTK). Kemmis (David, 2011) mengemukakan bahwa penelitian tindakan merupakan salah satu bentuk penyelidikan refleksi diri yang dilaksanakan oleh para partisipan dalam situasi-situasi social (termasuk pendidikan) untuk meningkatkan rasionalitas dan keadilan dalam (a) praktik-praktik sosial dan pendidikan mereka sendiri, (b) pemahaman mereka tentang praktik-praktik ini, dan (c) situasi-siatuasi yang melingkupi pelaksanaan praktik-praktik tersebut. Melalui PTK, kekurangan atau kelemahan yang terjadi dalam proses belajar mengajar dapat terdeteksi untuk selanjutnya dicari solusi yang tepat (Dewantara, Zainuddin, Wati, Suyidno, Misbah, Haryandi, Rahmattulah, & Munir, 2020).

Melalui PTK, guru dapat meneliti sendiri terhadap praktik pembelajaran yang dilaksanakannya di dalam kelas, baik dilihat dari interaksi siswa dalam proses pembelajaran atau hasil pembelajaran secara reflektif. PTK dapat dilaksanakan secara terintegrasi dengan kegiatan pembelajaran di kelas sehari- hari sehingga tidak mengganggu tugas pokok guru. PTK yang dilakukan oleh guru dipandang sebagai uapaya untuk meningkatkan keprofessionalan seorang guru (Zainuddin, Dewantara, Wati, Misbah, uyidno, Haryandi, Rahmattulah, & Munir, 2019). Untuk meningkatkan pemahaman guru tentang PTK, maka tim pengabdian mengadakan pelatihan untuk membimbing guru MGMP (Musyawarah Guru Mata Pelajaran) Matematika SMA Kota Banjarmasin dalam pembuatan proposal PTK. Tujuan dari pengabdian ini adalah untuk memberikan pemahaman dan mengingat kembali tentang PTK.

## II. METODE

Pelaksanaan kegiatan pengabdian kepada masyarakat berlangsung selama 3 bulan dimulai pada 30 Juli s.d. 30 September 2019. Pengabdian ini dilaksanakan sebanyak tiga kali pertemuan. Pertemuan dilakukan 2 minggu sekali sesuai jadwal pertemuan MGMP. Konsultasi atau bimbingan proposal dilakukan secara pribadi saja kepada pembimbing melalui email ataupun dengan bertemu langsung. Tempat penyelenggaraannya di SMA Negeri 5 Banjarmasin. Pelaksana kegiatan ini terdiri dari tiga orang dosen dan satu orang mahasiswa sebagai tim pengabdian Program Studi Pendidikan Matematika FKIP Universitas Lambung Mangkurat Banjarmasin. Peserta pengabdian terdiri dari 57 orang peserta MGMP Matematika SMA Kota Banjarmasin.

Metode atau pendekatan yang digunakan dalam kegiatan ini meliputi bimbingan tentang bagaimana cara pembuatan proposal PTK. Adapun uraian metodenya adalah sebagai berikut:

a. Menjelaskan kepada peserta pelatihan mengenai konsep dasar PTK.
b. Membimbing peserta membuat draf proposal PTK.
c. Mendiskusikan kesulitan dalam pembuatan proposal PTK.
d. Membimbing peserta memperbaiki proposal PTK.
e. Menghasilkan proposal PTK yang dapat digunakan untuk penelitian.

Materi disampaikan oleh tim secara bergantian. Adapun susunan materi bimbingan penyusunan proposal PTK untuk peserta MGMP Matematika SMA Kota Banjarmasin yaitu tentang konsep dasar PTK, sistematika proposal PTK, dan contoh kerangka proposal PTK.

## III. HASIL DAN PEMBAHASAN

Persiapan dan koordinasi kegiatan dilaksanakan pada tanggal 8 Agustus 2019 di SMA Negeri 2 Banjarmasin. Kegiatan inti dilaksanakan pada tanggal 22 Agustus 2019. Susunan kegiatan adalah pembukaan, penyampaian materi, dan diskusi. Pelaksanaanya diikuti oleh guru MGMP Matematika SMA Kota Banjarmasin. Pelaksanaan kegiatan diawali dengan acara pembukaan yang dapat dilihat pada Gambar 1.

Gambar 1 Pembukaan kegiatan

Pelaksanaan pengabdian dibuka dengan sambutan dari Kepala SMA Negeri 5 Banjarmasin. Kegiatan pengabdian terselenggara karena adanya kerja sama antara Program Studi Pendidikan Matematika FKIP Universitas Lambung Mangkurat Banjarmasin dengan MGMP Matematika SMA Kota Banjarmasin. Pertemuan selanjutnya pada tanggal 5 September 2019 untuk berdiskusi tentang proposal yang akan dibuat oleh guru-guru seperti judul proposal, metode pelaksanaan, dan lain-lain.

Setelah kegiatan dibuka, kegiatan berikutnya ialah penyampaian materi oleh tim pengabdian. Berikut dokumentasi penyampaian materi oleh narasumber dapat dilihat pada Gambar 2.

Gambar 2 Penyampaian materi

Pada saaat tim menjelaskan materi, terjadi diskusi dan tanya jawab yang menarik dengan peserta. Peserta begitu antusias bertanya tentang bagaimana PTK dilaksanakan, materi apa saja yang dapat dijadikan untuk bahan PTK dan perangkat pembelajaran apa saja yang perlu disiapkan sebelum pelaksanaan PTK. Selain bertanya tentang bagaimana melaksanakan PTK, peserta juga berbagi pengalaman tentang kendala-kendala yang dihadapi ketika ingin melaksanakan PTK, baik yang berkaitan pemilihan materi, kondisi sekolah yang kurang mendukung, media pembelajaran yang dimiliki di sekolah, perangkat pembelajaran dan buku ajar/modul yang selama ini digunakan di sekolah, serta karakter dari siswa itu sendiri.

Hasil yang dicapai dalam kegiatan ini adalah sebagai berikut:

a. Peserta lebih mengenal yang dimaksud dengan PTK, manfaatnya, dan contoh-contoh-contoh judul PTK dalam rangka meningkatkan kualitas pembelajaran.
b. Peserta mulai berminat membuat proposal PTK karena difasilitasi tim pengabdian untuk konsultasi baik secara langsung maupun melalui email.
c. Peserta berkeinginan ketika proposal penelitian PTK telah selesai, tim pengabdian bersedia melakukan pendampingan ketika pelaksanaan penelitian.
d. Peserta berharap PTK yang telah dilaksanakan dapat dibuat dalam bentuk artikel yang nantinya dapat dipublikasi di jurnal untuk mendukung kenaikan pangkat.

Hasil yang dicapai pada kegiatan ini sejalan dengan manfaat pelaksanaan diadakannya kegiatan PTK oleh guru- guru. Dimana setelah guru melakukan PTK maka guru membuat laporan yang kemudian dikemas menjadi artikel ilmiah. Artikel ilmiah tersebut dapat dipublikasikan di prosiding seminar ataupun di jurnal ilmiah, yang nantinya dapat menyumbangkan kepada khazanah ilmu pengetahuan (Afandi, 2014). Salah satu luaran dari kegiatan ini adalah proposal PTK yang dibuat oleh peserta MGMP Matematika SMA Kota Banjarmasin. Berikut dokumentasi proposal yang telah dibuat tertera pada Gambar 3.

**PROPOSAL**
**PENELITIAN TINDAKAN KELAS**

MENINGKATKAN HASIL BELAJAR MATEMATIKA SISWA KELAS X SMA SABILAL MUHTADIN PADA MATERI SISTEM PERSAMAAN LINEAR MENGGUNAKAN MODEL PEMBELAJARAN *PROBLEM SOLVING*

Normayanti, S.Pd

NUPTK 3635766667220012

**SMA SABILAL MUHTADIN**

**BANJARMASIN**

**2019**

Gambar 3 Contoh proposal PTK yang dibuat oleh peserta

Proposal tersebut dibuat oleh seorang guru matematika untuk melihat bagaimana peningkatan hasil belajar matematika siswa pada materi sistem persamaan linier setelah dilaksanakan PTK. PTK direncanakan dilaksanakan sebanyak dua siklus dan tidak menutup kemungkinan akan ada siklus berikutnya setelah dilaksanakan tahap refleksi pada siklus ketiga.

Pada pelaksanaan kegiatan pengabdian ini, ada faktor yang mempengaruhi jalannya pengabdian.

a. Faktor Penunjang

Para peserta sangat tertarik dan bersemangat dalam mengikuti kegiatan ini. Hal ini dikarenakan materi yang diperoleh akan bermanfaat dalam peningkatan produktivitas pendidikan dengan pembuatan proposal PTK.

b. Faktor Penghambat

Hambatan yang ditemukan dalam kegiatan pengabdian adalah masalah keterbatasan waktu, jika dihadiri semua peserta MGMP Matematika SMA Kota Banjarmasin berjumlah 100 orang namun pada saat pelaksanaan berjumlah 57 orang.

Pelaksanaan pengabdian kepada masyarakat berupa bimbingan pembuatan proposal PTK untuk guru peserta MGMP Matematika SMA Kota Banjarmasin berjalan dengan lancar. Penelitian Tindakan Kelas sangat sesuai bagi guru untuk melakukan penelitian terhadap masalah praktis yang dialami guru dalam tugasnya sehari-hari sebagai pengelola pembelajaran di kelas (Bhoga, 2014). Melalui kegiatan pengabdian ini diharapkan para guru dapat melaksanakan PTK di tempat kerjanya masing-masing dalam rangka meningkatkan kualitas pembelajaran.

## IV. SIMPULAN

Kegiatan Pengabdian kepada Masyarakat berupa bimbingan pembuatan proposal PTK untuk guru peserta MGMP Matematika SMA Kota Banjarmasin telah dilaksanakan dengan lancer. Kegiatan ini sangat mendukung peningkatan kemampuan guru dalam rangka meningkatkan produktivitas guru dengan pembuatan proposal PTK. Guru mulai mengingat dan memahami kembali materi PTK dan menghasilkan proposal PTK.

## DAFTAR PUSTAKA

Afandi, M. (2014). Pentingnya penelitian tindakan kelas bagi guru dalam pembelajaran di sekolah dasar. *Jurnal Ilmiah Pendidikan Dasar, 1*(1), 1–19.

Bhoga, V. U. (2014). Kajian pelaksanaan penelitian tindakan kelas oleh guru-guru SD di Kecamatan Jerebu. *Jurnal Ilmiah Pendidikan, 1*(1), 27–36.

David, H. (2011). *Panduan guru, penelitian tindakan kelas*. Yogyakarta: Pustaka Pelajar.

Dewantara, D., Zainuddin, Z., Wati, M., Suyidno, S., Misbah, M., Haryandi, S., Munir, M. J. M. (2020).Training and assistance in preparing class action research proposals for science teachers in Hulu Sungai Tengah regency. *Indonesian Journal of Science and Education*, *4*(1), 30–34.

Kunandar. (2011). *Langkah mudah penelitian tindakan kelas sebagai pengembangan profesi guru*. Jakarta: PT Raja Grafindo Persada.

Mastuang, M., Mahtari, S., Salam, A., Susilowati, E., Rizki, M., & Ramadhan, R. (2020). Pelatihan penyusunan proposal penelitian tindakan kelas bagi guru-guru fisika di Kabupaten Hulu Sungai Tengah. *Bubungan Tinggi: Jurnal Pengabdian Masyarakat, 1*(2), 61–65.

Ni'mah, Z. A. (2017). Urgensi penelitian tindakan kelas bagi peningkatan profesionalitas guru antara cita dan fakta. *Realita, 15*(2), 1–22.

Saifulloh, M., Muhibbin, Z., & Hermanto, H. (2012). Strategi peningkatan mutu pendidikan di sekolah. *Jurnal Sosial Humaniora (JSH, 5*(2), 206–218.

Sudibyo, D. (2013). Profil kompetensi guru bahasa inggris dalam pemanfaatan teknologi informasi dan komunikasi (TIK) untuk pembelajaran di Kabupaten Sorong. *Jurnal Pendidikan, 1*(2), 6–13.

Zainuddin, Z., Dewantara, D., Wati, M., Misbah, M., Suyidno, S., Haryandi, S., … Munir, M. J. M. (2019). Pelatihan dan pendampingan penyusunan proposal penelitian tindakan kelas (PTK) bagi guru IPA di Kabupaten Hulu Sungai Tengah. *Bubungan Tinggi: Jurnal Pengabdian Masyarakat, 1*(2), 79–84.

# 20. Kecerdasan Logita-Matematika Berdasarkan Multiple Intelegences Terhadap Kemampuan Matematika Siswa SMP di Banjarmasin

Gilang Zulfairanatama, Sutarto Hadi
Universitas Lambung Mangkurat Banjarmasin

**ABSTRAK**

Pengembangan kecerdasan hingga tingkat kompetensi yang memadai merupakan kunci utama *multiple intelligences*. Hal tersebut menjadi solusi bagi siswa dengan kecerdasan logika- matematika yang rendah agar dapat meningkatkan kemampuan matematikanya. Oleh karena itu, penelitian ini bertujuan untuk mengetahui pengaruh kecerdasan logika-matematika berdasarkan *multiple intelligences* terhadap kemampuan matematika pada siswa SMP di Banjarmasin tahun 2013. Peneliti menggunakan metode deskriptif dengan populasi yaitu kelas VIII pada SMPN 2, SMPN 9, SMPN 31, SMP Islam Sabilal Muhtadin, dan MTsN Mulawarman di Banjarmasin. Sampel dipilih satu kelas dari tiap sekolah secara acak. Teknik analisis data menggunakan uji regresi linear sederhana. Hasil penelitian menunjukkan (1) kecerdasan logika-matematika dalam kategori cukup,(2) kemampuan matematika dalam kategori cukup,(3) terdapat pengaruh positif dan signifikan antara kecerdasan logika-matematika dan kemampuan matematika siswa.

Kata kunci: multiple intelligences, kecerdasan logika-matematika, kemampuan matematika

## I. INTRODUCTION

*Tracking* menurut Chatib (2012) adalah pengelompokkan siswa ke dalam beberapa kelas berdasarkan kemampuan kognitifnya. Di sekolah-

sekolah, siswa dikelompokkan menjadi siswa bodoh dan siswa cerdas. Siswa yang dicap bodoh akan merasa malu, bersalah, takut, marah, dan emosi negatif lainnya yang mencegah kecerdasannya tumbuh dan berkembang. Hal tersebut sangat berbahaya karena dapat melumpuhkan kecerdasan.

Di Banjarmasin, pengelompokkan siswa menjadi bodoh dan cerdas sering terjadi. Hal ini dapat diamati dari sistem penerimaan siswa baru. Salah satu SMP unggulan di Banjarmasin untuk penerimaan siswa baru tahun pelajaran 2012-2013, menggelar tes akademik tertulis, tes psikologis, tes komputer, tes bahasa inggris, dan wawancara bagi orang tua. Dari 322 calon, kuota hanya tersedia untuk 284 siswa. Siswa yang tidak lulus tes masuk akan merasa malu, marah, sedih, dan emosi negatif lainnya. Sedangkan sekolah-sekolah reguler di Banjarmasin menerima siswa baru dengan syarat nilai Ujian Nasional (UN). Siswa-siswa dengan nilai UN yang rendah akan tersisih dan harus mendaftar di sekolah pinggiran.

Sekolah-sekolah di Indonesia memberikan label bodoh pada siswa yang kecerdasan logika- matematikanya rendah. Kecerdasan ini menurut Jasmine (2007) sering dipandang dan dihargai lebih tinggi daripada jenis-jenis kecerdasan lainnya, khususnya dalam masyarakat teknologi kita dewasa ini. Biasanya, guru menentukan tinggi-rendahnya kecerdasan ini dari kemampuan matematika siswa. Oleh karena itu, penting bagi siswa untuk mengembangkan kecerdasan logika-matematika, agar kemampuan matematikanya meningkat.

Solusi bagi permasalahan tersebut dapat ditemukan dalam teori *multiple intelligences*. Salah satu kunci utama teori ini menurut Armstrong (2013) adalah banyak orang bisa mengembangkan masing- masing kecerdasan hingga ke tingkat kompetensi yang memadai. Misalnya, dalam *Suzuki Talent Education Program* yang dijelaskan oleh Gardner(1993) bahwa orang-orang dengan kemampuan musikal rendah dapat mencapai tingkat kemahiran yang tinggi dalam bermain biola atau piano, karena kombinasi pengaruh lingkungan yang tepat.

Penelitian ini bertujuan untuk (1) mendeskripsikan kecerdasan logika matematika berdasarkan *multiple intelligences* siswa SMP di Banjarmasin tahun 2013, (2) mendeskripsikan kemampuan matematika siswa SMP di Banjarmasin tahun 2013, (3) mengetahui pengaruh kecerdasan logika-matematika berdasarkan *multiple intelligences* terhadap kemampuan matematika pada siswa SMP di Banjarmasin tahun 2013.

Multiple Intelligences adalah teori yang merupakan redefinisi kecerdasan sehingga sangat kontroversial ketika pertama kali dimunculkan tahun 1983 oleh Gardner. Menurut Gardner (1993) kompetensi kecerdasan manusia

memerlukan sekumpulan keterampilan dalam pemecahan masalah, juga memerlukan potensi dalam menemukan atau menciptakan masalah. Definisi ini fokus pada (1) kemampuan membuat produk-produk baru yang bernilai budaya (kreativitas), dan (2) kemampuan menyelesaikan masalah (*problem solving*). Redefinisi kecerdasan tersebut mengakibatkan perubahan paradigma mendasar terhadap definisi-definisi kecerdasan yang telah berkembang sebelum munculnya *multiple intelligences*. Menurut Chatib (2012) ada 3 perubahan paradigma mendasar, yaitu (1) kecerdasan tidak dibatasi tes formal, (2) kecerdasan itu multidimensi, dan (3) kecerdasan merupakan proses *discovering ability*.

*Multiple intelligences* terus berkembang dari waktu ke waktu hingga sekarang. Hal tersebut sesuai dengan salah satu paradigma mendasar bahwa kecerdasan bersifat multidimensi. Menurut Yaumi (2012) saat ini *multiple intelligences* terdiri dari daftar 8 jenis kecerdasan yang "sah", yaitu (1) verbal-linguistik,(2) logika-matematika,(3) visual- spasial,(4) jasmaniah-kinestetik,(5) musikal-berirama,(6) interpersonal**,** (7) intrapersonal, dan(8) naturalistik. Poin-poin tertentu dari *multiple intelligences* yang penting untuk diingat (Armstrong, 2013) yaitu (1)Setiap orang memiliki semua 8 kecerdasan, (2) banyak orang bisa mengembangkan masing-masing kecerdasan hingga ke tingkat kompetensi yang memadai, dan (3) kecerdasan- kecerdasan biasanya bekerja bersama-sama dalam cara yang kompleks, serta (4) ada banyak cara untuk menjadi cerdas dalam setiap kategori

Kecerdasan Logika-Matematika menurut Yaumi (2012) adalah kemampuan yang berkenaan dengan rangkaian alasan, mengenal pola-pola dan aturan. Kemampuan ini sering disebut berpikir kritis. Kecerdasan logika-matematika menurut Armstrong (2013) adalah kemampuan menggunakan angka secara efektif dan untuk alasan yang baik. Kecerdasan ini meliputi kepekaan terhadap pola- pola dan hubungan-hubungan yang logis, pernyataan dan dalil (jika-maka, sebab-akibat), fungsi, dan abstraksi terkait lainnya. Sedangkan menurut Jasmine (2007) kecerdasan ini berhubungan dengan dan mencakup kemampuan ilmiah. Jenis kecerdasan ini sering dicirikan sebagai bagian dari metode ilmiah. Dengan demikian dapat disimpulkan bahwa kecerdasan logika-matematika adalah kemampuan ilmiah untuk memahami suatu konsep dan secara prosedural menghubungkan pola-pola abstrak dalam memecahkan suatu masalah.

Ada dua kemampuan kunci dari kecerdasan logika-matematika menurut Baum, et. al (2005) yaitu (1) *Enables individuals to use and appreciate*

*abstract relations* (2) *Includes facility in the use of numbers and logical thinking* (memungkinkan individu untuk menggunakan dan memahami hubungan abstrak, termasuk kecakapan dalam penggunaan angka dan logika berpikir). Jenis- jenis proses yang lain menurut Armstrong (2013) mencakup kategorisasi, klasifikasi, kesimpulan, generalisasi, penghitungan, dan pengujian hipotesis. Karakteristik ini digunakan untuk membangun model dan teori dalam suatu sistem operasi. Oleh karena itu, kecerdasan logika-matematika tidak hanya terbatas pada matematika saja, tetapi juga mencakup kemampuan ilmiah dalam bidang lainnya. Kecerdasan logika-matematika dapat dikembangkan menggunakan semua mata pelajaran di sekolah, tidak terbatas pada mata pelajaran matematika saja. Menurut Armstrong (2013) ada 5 strategi utama untuk mengembangkan kecerdasan logika-matematika yang dapat digunakan dalam semua mata pelajaran di sekolah, sebagai berikut: (1) Perhitungan dan kuantifikasi, (2) klasifikasi dan kategorisasi, (3) pertanyaan model Socrates, dan (4) heuristik, serta (5) pemikiran/Berpikir Ilmiah. Mencermati hal tersebut, dapat disimpulkan bahwa aktivitas untuk mengembangkan kecerdasan logika-matematika sangatlah luas dan tidak terbatas pada mata pelajaran matematika saja. Perlu pengkajian lebih lanjut tentang aktivitas lainnya, sebagai tambahan untuk melengkapi berbagai jenis kegiatan pembelajaran yang mampu mengembangkan kecerdasan logika-matematika.

Kemampuan matematika merupakan salah satu komponen dari kekuatan matematika. *Mathematical power* (kekuatan matematika) menurut Division of Curriculum and Instruction Secondary Mathematics Pinellas Country Schools (2007) terdiri dari (1) *content strands*, (2) *mathematical ability*, dan (3) *process standards*. Lebih lanjut, disebutkan bahwa *mathematical ability* (kemampuan matematika) terdiri dari *conceptual understanding* (pemahaman konseptual) dan *procedural knowledge* (pengetahuan prosedural). Siswa dengan kemampuan matematika tinggi memiliki beberapa ciri, di antaranya seperti yang disebutkan Borovik dan Gardiner (2006) yaitu *ability to make and use generalisations–often quite quickly* (kemampuan untuk membuat dan menggunakan generalisasi– seringkali dengan sangat cepat). Selain itu, Borovik dan Gardiner (2006) juga menyebutkan *ability to utilize analogies and make connections* (kemampuan untuk menggunakan analogi dan membuat koneksi).

Keterkaitan antara kecerdasan logika- matematika dan kemampuan matematika dapat dilihat dari komponen yang dilibatkannya. Campbell, et. al (1996) mengungkapkannya dalam pernyataan"*Logical-mathematical in-*

*telligence involves numerous components: mathematical calculation, logical thinking, problem-solving, deductive and inductive reasoning, and the discernment of patterns and relationship"* (kecerdasan logika-matematika melibatkan banyak komponen: perhitungan matematika, logika berpikir, *problem-solving*, penalaran deduktif dan induktif, serta membedakan pola dan hubungan). Komponen- komponen tersebut sangat diperlukan dalam pembelajaran matematika di sekolah.

Salah satu kunci utama *multiple intelligences*yaitu kecerdasan biasanya bekerja secara bersama-sama dalam cara yang kompleks. Dalam hal ini, kecerdasan selalu berinteraksi satu sama lain ketika melakukan suatu aktivitas, begitu pula ketika memecahkan *problem* matematis. Oleh karena itu, dapat dipahami bahwa kemampuan matematika tidak hanya dipengaruhi oleh kecerdasan logika-matematika saja. Kecerdasan lain yang ikut berperan terhadap kemampuan matematika dapat mengaburkan hubungan antara kecerdasan logika-matematika dan kemampuan matematika. Pengaruh kecerdasan logika- matematika akan berkurang disebabkan pengaruh kecerdasan lain yang lebih dominan. Sedangkan kecerdasan lain yang tidak berperan terhadap kemampuan matematika dapat memperjelas hubungan antara kecerdasan logika-matematika dan kemampuan matematika. Oleh karena itu, penting untuk memperkirakan kecerdasan mana saja yang ikut berperan dalam kemampuan matematika. Kecerdasan lain yang ikut mempengaruhi kemampuan matematika di antaranya kecerdasan verbal-linguistik (dalam menterjemahkan soal tertulis), visual-spasial (dalam memvisualisasikan soal), dan intrapersonal (dalam refleksi diri dan berpikir lebih mendalam).

## II. METODE

Variabel bebasnya yaitu kecerdasan logika- matematika berdasarkan *multiple intelligences*. Sedangkan variabel terikatnya yaitu kemampuan matematika siswa SMP di Banjarmasin berupa hasil tes.

Populasi dalam penelitian ini adalah seluruh siswa kelas VIII pada SMPN 2 Banjarmasin, SMPN 9 Banjarmasin, SMPN 31 Banjarmasin, MTsN Mulawarman, dan SMP Islam Sabilal Muhtadin. Pengambilan sampel menggunakan teknik *cluster sampling*. Teknik ini menurut Narbuko dan Achmadi (2009) menghendaki adanya kelompok-kelompok dalam pengambilan sampel berdasarkan atas kelompok-kelompok yang ada dalam populasi. Jadi, dalam penelitian ini populasi sengaja dipandang

berkelompok-kelompok sesuai kelas siswa; A, B, C, dan seterusnya. Setelah itu sampel diambil secara acak masing-masing satu kelas VIII dari tiap sekolah.

Tabel 1 Penyebaran Sampel Penelitian

| No | Nama Sekolah | Banyak Kelas | Kelas Terpilih | Jumlah Siswa |
|---|---|---|---|---|
| 1 | SMPN 2 Banjarmasin | 7 | VIII E | 31 |
| 2 | SMPN 9 Banjarmasin | 8 | VIII B | 36 |
| 3 | SMPN 31 Banjarmasin | 5 | VIII D | 31 |
| 4 | MTsN Mulawarman | 6 | VIII A | 38 |
| 5 | SMP Islam Sabilal Muhtadin | 4 | VIII A | 24 |
| | Jumlah | 30 | 5 | 160 |

Ada dua instrumen yang digunakan yaitu angket dan soal tes kemampuan matematika. Angket berjenis *rating scale* digunakan untuk melihat kecerdasan responden berdasarkan *multiple intelligences* dalam skala bertingkat. *Rating scale* terdiri dari total 80 pertanyaan yang diadaptasi dari *checklist* menurut Kaudfelt (2008). Adapun pembagiannya, masing-masing dari 8 jenis kecerdasan terdiri dari 10 pertanyaan. Angket terdiri dari empat skala penilaian: sangat tidak setuju, tidak setuju, setuju, dan sangat setuju. Rentangan skala yang digunakan adalah 1 – 4, maka skor terendah seorang siswa adalah 10 (10 × 1 = 10) dan skor tertinggi adalah 40 (10 × 4 = 40). Dengan demikian mediannya adalah (10 + 40)/2 = 25.

Tabel 2 Kisi-kisi Angket

| Variabel | Indikator | No. Pernyataan |
|---|---|---|
| Kecerdasan logika-matematika berdasarkan *multiple intelligences* | - Kemampuan menggunakan angka | 1, 4, 9 |
| | - Berpikir dan berperilaku teratur sesuai urutan logis | 2, 5, 6 |
| | - Mencari tahu prosedur kerja suatu hal | 3, 8 |
| | - Ketertarikan pada suatu aktivitas (hobi) | 7, 10 |

Pada instrumen soal tes kemampuan matematika materi soal diambil dari bahan ajar semester 1 dan 2, dengan pertimbangan bahwa materi tersebut sudah selesai diajarkan. Jumlah soal sebanyak 5 disesuaikan dengan waktu penelitian yang disediakan oleh sekolah dan juga mempertimbangkan standar kompetensi dan kompetensi dasar kelas VIII. Untuk rinciannya disajikan dalam tabel sebagai berikut.

Tabel 3 Penentuan Jumlah Soal Tes Kemampuan Matematika

| Standar Kompetensi Ke- | Semester | Materi | Jumlah Soal |
|---|---|---|---|
| 1 | | Aljabar | 2 |
| 2 | 1 | Aljabar | 1 |
| 3 | | Geometri dan pengukuran | 1 |
| 4 | 2 | Geometri dan pengukuran | 1 |
| 5 | | Geometri dan pengukuran | 0 |
| | Jumlah Total | | 5 |

Teknik analisis data dibagi menjadi 3 yaitu : (1) analisis uji pendahuluan yaitu uji validitas dan reliabilitas, (2) statistik deskriptif yaitu rata-rata, standar deviasi, *coefficient of variations*, dan Penilaian Acuan Normatif (PAN), (3) statistik inferensial yaitu uji normalitas, uji korelasi, dan uji regresi linear sederhana. Sebelumnya, dilakukan uji coba soal tes kemampuan matematika untuk : mengetahui validitas dan reliabilitas. Uji coba soal tes dilakukan di SMPN 5 Banjarmasin dan SMPN 10 Banjarmasin.

Dalam menentukan validitas suatu instrumen seperti tes matematika bentuk uraian digunakan rumus korelasi*product moment*. Rumus yang digunakan menurut Arikunto 2010)

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\{N\sum X^2 - (\sum X)^2\}\{N\sum Y^2 - (\sum Y)^2\}}}$$

Keterangan:
$r_{xy}$ = indeks korelasi antara variabel X dengan variabel Y
$N$ = jumlah sampel
$X$ = skor tiap soal ($X_1, X_2, X_3, ..., X_N$)
$Y$ = skor total tiap individu ($Y_1, Y_2, Y_3, ..., Y_N$)

Untuk mencari reliabilitas instrumen yang skornya merupakan rentangan nilai antara beberapa nilai (misalnya 0-10 atau 0-100) atau yang berbentuk skala 1-3, 1-5 atau 1-7 dan seterusnya digunakan rumus Alpha (Arikunto, 2010):

5X
5_
"_
5C
)

$$r_{11} = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum \sigma_b^2}{\sigma^2{}_t}\right)$$

Keterangan:
$r_{11}$ = reliabilitas instrumen
k = banyaknya butir pertanyaan atau banyaknya soal
$\sum \sigma_b^2$ = jumlah varians butir
$\sigma^2{}_t$ = varians total

Rata-rata digunakan untuk menggambar- kan tendensi penyebaran sentral dari suatu data. Dalam penelitian ini, nilai rata-rata juga digunakan untuk mendeskripsikan tingkat kecerdasan logika-matematika berdasarkan *multiple intelligences* dan kemampuan matematika siswa. Nilai rata-rata juga digunakan dalam statistik inferensial. Rumus dariSandjaja dan Heriyanto (2006):

$$\bar{x} = \frac{\sum x_i}{n}$$

Keterangan: $\bar{x}$ = rata-rata
$\sum x_i$ = jumlah dari nilai setiap individu
n = jumlah sampel

Standar deviasi menggambarkan variabilitas suatu data. Makin besar standar deviasi, makin bervariasi nilai-nilai data tadi. Standar deviasi juga digunakan dalam statistik inferensial. Standar deviasi (sd) dinyatakan dengan rumus Sandjaja dan Heriyanto (2006) berikut:

$$sd = \sqrt{\frac{n\sum x_i^2 - (\sum x_i)^2}{n(n-1)}}$$

Coefficients of Variations menurut Sandjaja dan Heriyanto (2006) mengukur variasi dan penyebaran data dari mean yang dipergunakan untuk membandingkan penyebaran dua jenis data secara relatif.

$$CV = \frac{sd}{\mu} \times 100$$

Keterangan: CV = *Coefficient of Variation*
$\mu$ = mean

Langkah-langkah pendekatan Penilaian Acuan Normatif (PAN) dalam skala-5 diadaptasi menurut Rofieq (2012) sebagai berikut: (1) Menghitung rata-rata ($\bar{x}$) data, (2) menghitung standar deviasi (sd) data, dan (3) mengkonversi skor menjadi nilai standar dengan acuan yang disajikan pada tabel berikut:

Tabel 4 Kategori nilai dengan pendekatan PAN

| Rentang Nilai | | Kategori |
|---|---|---|
| Nilai ≥ $\bar{x}$ + 1,5(sd) | A | Sangat tinggi |
| $\bar{x}$ + 0,5(sd) ≤ Nilai < $\bar{x}$ + 1,5(sd) | B | Tinggi |
| $\bar{x}$ − 0,5(sd) ≤ Nilai < $\bar{x}$ + 0,5(sd) | C | Cukup |
| $\bar{x}$ − 1,5(sd) ≤ Nilai < $\bar{x}$ − 0,5(sd) | D | Rendah |
| {$\bar{x}$ − 1,5 (sd)} − 1 ≤ Nilai < $\bar{x}$ − 1,5(sd) | E | Sangat rendah |

Rumus yang digunakan untuk uji normalitas adalah rumus *kai kuadrat* (chi kuadrat) dengan simbol $5^2$ (Kariadinata dan Abdurrahman, 2012).

$$\chi^2{}_{hitung} = \sum \left( \frac{(O_i - E_i)^2}{E_i} \right)$$

Keterangan: $\chi^2$ = chi kuadrat
$O_i$ = frekuensi hasil pengamatan pada klasifikasi ke-i
$E_i$ = frekuensi yang diharapkan pada klasifikasi ke-i

Untuk mencari koefisien korelasi antarvariabel digunakan teknik *product moment* dari Pearson (Kariadinata dan Abdurrahman, 2012), sebagai berikut.

$$r_{xy} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{\{N \sum X^2 - (\sum X^2)\}\{N \sum Y^2 - (\sum Y^2)\}}}$$

Keterangan: $r_{xy}$ = indeks korelasi antara variabel X dengan variabel Y
$N$ = jumlah sampel
$X$ = skor pada variabel bebas
$Y$ = skor pada variabel terikat

Untuk mengetahui seberapa besar variabel bebas memengaruhi variabel terikat digunakan rumus koefisien determinasi (R), sebagai berikut:

$$R = (rxy)^2$$

Bentuk umum regresi linear sederhana menurut Kariadinata dan Abdurrahman (2012):

$$\hat{Y} = a + bX$$

Keterangan: $\hat{Y}$ = subjek dalam variabel tak bebas yang diprediksikan
X = subjek pada variabel terikat yang mempunyai nilai tertentu
a = harga Y apabila X = 0 (harga konstanta)
b = angka arah atau koefisien regresi yang menunjukkan angka peningkatan atau penurunan variabel bebas

Untuk menentukan persamaan regresi linear, perlu ditentukan nilai a dan nilai b yang dicari dengan menggunakan rumus berikut:

$$a = \frac{\sum X_i^2 . \sum Y_i - \sum X_i . \sum X_i Y_i}{n \sum X_i^2 - (\sum X_i)^2} \text{ dan } b = \frac{n \sum X_i Y_i - \sum X_i . \sum Y_i}{n \sum X_i^2 - (\sum X_i)^2}$$

## III. HASIL DAN PEMBAHASAN

Sesuai kaidah, butir soal dikatakan valid jika $r_{xy}$ hitung lebih besar daripada $r_{xy}$ tabel. Berdasarkan hasil perhitungan, disajikan uji validitas sebagai berikut.

Tabel 5 Uji Validitas

| Soal ke- | $r_{xy}$ hitung | $r_{xy}$ tabel | Validitas |
|---|---|---|---|
| 1 | 0,683 | 0,254 | valid |
| 2 | 0,869 | 0,254 | valid |
| 3 | 0,724 | 0,254 | valid |
| 4 | 0,858 | 0,254 | valid |
| 5 | 0,593 | 0,254 | valid |

Sesuai kaidah, suatu instrumen dikatakan reliabel jika nilai r11 lebih dari nilai $r_{xy}$ tabel. Berdasarkan hasil perhitungan $r_{xy}$ hitung= 0,775 dan $r_{xy}$ tabel= 0,254 sehingga dapat disimpulkan instrumen tersebut reliabel. Adapun hasil perhitungan rata-rata disajikan sebagai berikut.

Tabel 6 Perhitungan Rata-Rata

| | Kecerdasan Logika-Matematika | Kemampuan Matematika |
|---|---|---|
| Skor terendah | 10 | 0 |
| Skor tertinggi | 39 | 96 |
| Rata-rata | 25,56 (63,9%) | 49,03% |

Diperoleh Berdasarkan hasil perhitungan standar deviiasi untuk kecerdasan logika matematika adalah 7,24 dan kemampuan matematika adalah 25,00. Untuk membandingkan variasi dari kedua variabel digunakan nilai *Co-efficient of Variation* dimana untuk kecerdasan logika matematika adalah 28,32 dan kemampuan matematika 51,00.

Dapat dilihat bahwa nilai tes kemampuan matematika lebih bervariasi daripada skoring angket kecerdasan logika-matematika. Mencermati hal tersebut, kemampuan matematika memiliki variasi yang lebih besar dipengaruhi oleh kombinasi kecerdasan yang berbeda-beda pada tiap individu.

Tidak ada individu yang sama dalam kombinasi kecerdasannya. Gardner dalam Armstrong (2013) mengatakan bahwa kita semua begitu berbeda terutama karena kita semua memiliki kombinasi yang berbeda dari kecerdasan-kecerdasan.

Data skor angket kecerdasan logika- matematika dikategorikan dalam skala-5 menggunakan pendekatan Penilaian Acuan Normatif (PAN) disajikan sebagai berikut.

Tabel 7 Kategori Kecerdasan Logika-Matematika

| Interval Skor | Nilai | Keterangan | Frekuensi | Persentase (%) |
|---|---|---|---|---|
| 36 ke atas | A | Sangat tinggi | 12 | 7,5 |
| 29 – 35 | B | Tinggi | 45 | 28,125 |
| 22 – 28 | C | Cukup | 61 | 38,125 |
| 15 – 21 | D | Rendah | 31 | 19,375 |
| 14 ke bawah | E | Sangat rendah | 11 | 6,875 |
| | Jumlah | | 160 | 100 |

Dari hasil perhitungan nilai rata-rata skor angket sebesar 25,56 dibandingkan dengan kategori kecerdasan logika-matematika tersebut, maka nilai rata-rata berada pada kategori cukup. Sehingga disimpulkan bahwa kecerdasan logika-matematika siswa SMP berada dalam kategori cukup atau sedang. Sedangkan untuk data nilai tes kemampuan matematika, dikategorikan dalam skala-5 mengguna- kan pendekatan Penilaian Acuan Normatif (PAN) disajikan sebagai berikut.

Tabel 8 Kategori Kemampuan Matematika

| Interval Skor | Nilai | Keterangan | Frekuensi | Persentase (%) |
|---|---|---|---|---|
| 87 ke atas | A | Sangat tinggi | 7 | 4,375 |
| 62 – 86 | B | Tinggi | 45 | 28,125 |
| 37 – 61 | C | Cukup | 56 | 35 |
| 12 – 36 | D | Rendah | 41 | 25,625 |
| 11 ke bawah | E | Sangat rendah | 11 | 6,875 |
| | Jumlah | | 160 | 100 |

Dari perhitugan nilai rata-rata tes matematika sebesar 49,03 dibandingkan dengan kategori kemampuan matematika tersebut, maka nilai rata-rata berada pada kategori cukup. Sehingga disimpukan bahwa kemampuan matematika siswa SMP berapa pada kategori cukup atau sedang. Pada uji normalitas, kriteria uji chi kuadrat adalah data berdistribusi normal jika $X^2$*hitung*< $X^2$*tabel*. Hasil perhitungan disajikan sebagai berikut.

Tabel 9 Uji normalitas

| | $\chi^2_{hitung}$ | $\chi^2_{tabel}$ | Distribusi |
|---|---|---|---|
| **Kecerdasan logika-matematika** | 7,1311 | 11,1 | Normal |
| **Kemampuan matematika** | 8,394 | 11,1 | Normal |

Dari hasil perhitungan dengan rumus angka kasar didapat koefisien korelasi yang bernilai positif, yaitu 0,368 berarti terdapat korelasi positif di antara kedua variabel. Besarnya $r_{xy}$ yang diperoleh adalah terletak pada interval 0,200 – 0,400, maka diberikan interpretasi: *terdapat korelasi positif yang rendah di antara kecerdasan logika-matematika berdasarkan multiple intelligences dan kemampuan matematika siswa SMP*. Untuk mengetahui signifikansi korelasi, harga $r_{xy}$ dibandingkan dengan harga kritik r. Koefisien korelasi yang didapat dari perhitungan sebesar 0,368. Dengan derajat kebebasan (dk) 158 dan taraf signifikansi 5%, diperoleh harga kritik sebesar 0,159. Dalam hal ini harga $r_{xy}$ lebih dari harga kritik, sehingga disimpulkan bahwa terdapat korelasi positif yang signifikan. Dari hasil perhitungan diperoleh nilai koefisien determinasi sebesar 13,54% menunjukkan bahwa 13,54% kemampuan matematika siswa SMP di Banjarmasin dipengaruhi oleh kecerdasan logika- matematika berdasarkan *multiple intelligences*, sedangkan sisanya yaitu 86,46% dipengaruhi oleh faktor lain.

Setelah diperoleh nilai a = 17,34 dan b = 1,24 maka regresi linear sederhana disusun dengan persamaan 5L▪ = 17,34 + 1,245K. Persamaan tersebut menyatakan hubungan antara kecerdasan logika-matematika berdasarkan *multiple intelligences* (X) terhadap kemampuan matematika (Y) siswa SMP di Banjarmasin. Persamaan 5L▪ = 17,34 + 1,245K, berarti setiap kenaikan kecerdasan logika- matematika (X) sebesar 1 satuan, maka kemampuan matematika akan meningkat sebesar 1,24 satuan. Sederhananya, persamaan tersebut menunjukkan bahwa jika kecerdasan logika-matematika meningkat, maka kemampuan matematika juga akan meningkat, dan sebaliknya. Berikut juga disajikan output SPSS untuk mengetahui linieritas dan taraf signifikansi.

Tabel 10 *Output* SPSS Uji Regresi Linear Sederhana

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 17.342 | 6.633 | | 2.615 | .010 |
| | skor_LM | 1.240 | .249 | .368 | 4.974 | .000 |

a. Dependent Variable: nilai_tes

Pada sig. didapatkan nilai 0,000. Ketentuannya, jika nilai sig. kurang dari 0,05 maka persamaan regresi adalah signifikan dan linier, dan sebaliknya. Sesuai ketentuan, maka disimpulkan bahwa model persamaan regresi adalah signifikan dan memenuhi kriteria linieritas.

## SIMPULAN DAN SARAN

### Simpulan

Berdasarkan hasil penelitian dapat disimpulkan bahwa:

(1) Kecerdasan logika-matematika berdasarkan *multiple intelligences* siswa SMP di Banjarmasin tahun 2013 berada dalam kategori cukup.
(2) Kemampuan matematika siswa SMP di Banjarmasin tahun 2013 berada dalam kategori cukup. Juga diketahui bahwa kemampuan matematika siswa sangat bervariasi, disebabkan oleh kombinasi kecerdasan-kecerdasan yang berbeda antara satu siswa dengan siswa lain.
(3) Terdapat pengaruh positif dan signifikan antara kecerdasan logika-matematika berdasarkan *multiple intelligences* terhadap kemampuan matematika pada siswa SMP di Banjarmasin tahun 2013. Jika kecerdasan logika-matematika meningkat, maka kemampuan matematika juga akan meningkat, dan sebaliknya.

### SARAN

Berdasarkan kesimpulan di atas dapat dikemukakan beberapa saran sebagai berikut:

(1) Bagi siswa, hendaknya dapat mengidentifikasi kecerdasan dominan yang dimilikinya. Juga diharapkan siswa dapat mengembangkan kecerdasan logika-matematika berdasarkan *multiple intelligences* dan jenis kecerdasan lain yang ikut berpengaruh untuk meningkatkan kemampuan matematikanya.
(2) Bagi guru, khususnya dalam mata pelajaran matematika, disarankan untuk mengetahui kecenderungan kecerdasan mana yang dominan pada siswa. Selanjutnya, guru dituntut kreatif dalam mengajar agar setiap anak yang kecenderungan kecerdasannya berbeda-beda dapat memahami pelajaran dengan baik.
(3) Bagi peneliti, diharapkan dapat dilakukan penelitian lebih lanjut mengenai pengaruh 7 jenis kecerdasan yang lain, selain logika- matematika,

terhadap kemampuan matematika pada siswa SMP. Diharapkan juga dilakukan penelitian lebih lanjut dengan mengembangkan strategi pembelajaran sesuai metode *multiple intelligences* untuk penelitian tindakan/ eksperimen.

## DAFTAR PUSTAKA


Arikunto, S. 2010. *Prosedur Penelitian: Suatu Pendekatan Praktik*. Rineka Cipta, Jakarta.

Armstrong, T. 2013. *Kecerdasan Multipel di dalam Kelas*. Edisike-3 diterjemahkan oleh Dyah Widya Prabaningrum. Indeks, Jakarta.

Baum, S., B. Viens, B. Slatin. 2005. *Multiple Intelligences in The Elementary Classroom: A Teacher's Toolkit*. Teacher Colleges, Columbia University.

Borovik, A.V. & T. Gardiner. 2006. *Mathematical Abilities and Mathematical Skills*. The University of Manchester, Cambridge.

Chatib, M. 2012. *Sekolahnya Manusia*. Kaifa, Bandung.

Division of Curriculum and Instruction Secondary Mathematics Pinellas Country Schools. 2007. *Mathematical Power for All Students K-12*. Pinellas Country School, Indianapolis.

Gardner, H. 1993. *Frames Of Mind: The Theory Of Multiple Intelligences*. Basic Books, USA.

Jasmine, J. 2007. *Mengajar dengan Metode Kecerdasan Majemuk: Implementasi Multiple Intelligences*. Nuansa, Bandung.

Kaudfelt, M. 2008. *Wahai Para Guru, Ubahlah Cara Mengajarmu: Perintah Pengajaran yang berbeda-beda dan sesuai dengan otak*. Diterjemahkan oleh Hendarto Raharjo. Indeks, Jakarta.

Kariadinata, R. & M. Abdurahman. 2012. *Dasar- Dasar Statistik Pendidikan*. Pustaka Setia, Bandung.

Narbuko, C. & A. Achmadi. 2009. *Metodologi Penelitian*. Bumi Aksara, Jakarta.

Rofieq, A. 2012. *Asesmen Pembelajaran di SD*. Dikti, Jakarta.

Sandjaja, B. & A. Heriyanto. 2006. *Panduan Penelitian*. Prestasi Pustaka, Jakarta.

Yaumi, M. 2012. *Pembelajaran Berbasis Multiple Intelligences*. Dian Rakyat, Jakarta.

# 21. Metode Pemecahan Masalah Menurut Poyla untuk Mengembangkan Kemampuan Siswa dalam Pemecahan Masalah Matematis di Sekolah menengah Pertama

Sutarto Hadi, Radiyatul
Universitas Lambung Mangkurat Banjarmasin

**ABSTRAK.**

Pemecahan masalah merupakan bagian dari pembelajaran matematika yang sangat penting karena dalam proses pembelajaran maupun penyelesaiannya, siswa dimungkinkan memperoleh pengalaman menggunakan pengetahuan yang sudah dimiliki. Salah satu metode pemecahan masalah adalah dengan menggunakan metode pemecahan masalah menurut Polya. Ada 4 langkah fase penyelesaian masalah menurut Polya yaitu memahami masalah, membuat rencana pemecahan masalah, melakukan rencana penyelesaian dan memeriksa kembali hasil penyelesaian. Berdasarkan hal tersebut dilakukan penelitian yang bertujuan untuk mengetahui perkembangan kemampuan pemecahan masalah siswa dan mengetahui apakah terdapat perbedaan yang signifikan dari hasil belajar siswa antara sebelum dan sesudah diberikan metode pemecahan masalah menurut Polya. Penelitian ini menggunakan metode quasi experiment, dengan populasi seluruh siswa kelas VIII SMP Negeri 6 Banjarmasin. Pengambilan sampel menggunakan teknik random sampling, yaitu mengambil 1 kelas secara acak sebagai kelas eksperimen yaitu kelas VIII-B. Teknik pengumpulan data yang digunakan adalah wawancara, dokumentasi dan tes. Teknik analisis yang digunakan adalah statistika deskriptif dan statistika inferensial. Hasil penelitian menunjukkan bahwa kemampuan pemecahan masalah siswa lebih tinggi pada tiap pertemuan dan hasil belajar siswa yang

menggunakan metode pemecahan masalah menurut Polya berada pada kualifikasi amat baik. Berdasarkan uji statistik menunjukan bahwa terdapat perbedaan yang signifikan antara kemampuan pemecahan masalah siswa pertemuan pertama dengan pertemuan kelima dan terdapat perbedaan yang signifikan juga dari hasil belajar siswa antara sebelum dan sesudah diberikan metode pemecahan masalah menurut Polya.

Kata kunci: metode pemecahan masalah, Polya, pemecahan masalah, hasil belajaradalah berhadapan dengan masalah. Kita perlu

## I. PENDAHULUAN

National Council of Teachers of Mathematics menyatakan bahwa pembelajaran matematika hendaknya dilakukan dalam upaya untuk mengembangkan kemampuan pemecahan masalah, penalaran dan pembuktian, koneksi matematika, komunikasi matematika, dan representasi (NCTM, 2000). Dapat disimpulkan bahwa pemecahan masalah merupakan salah satu tujuan dalam pembelajaran matematika. Memecahkan suatu masalah merupakan suatu aktivitas dasar bagi manusia. Kenyataan menunjukkan, sebagian besar kehidupan kita menyelesaikan masalah tersebut, apabila kita gagal dalam menyelesaikan suatu masalah maka kita harus mencoba menyelesaikannya dengan cara lain. Kita harus berani menghadapi masalah untuk menyelesaikannya. Dengan demikian, pemecahan masalah merupakan metode pembelajaran yang baik untuk diajarkan di sekolah.

Tidak bisa dipungkiri bahwa manusia dalam kehidupannya selalu akan dihadapkan pada suatu masalah yang memerlukan suatu keterampilan dan kemampuan untuk memecahkannya. Mengajar siswa untuk menyelesaikan masalah-masalah memungkinkan siswa itu menjadi lebih kritis dan kreatif dalam mengambil keputusan dalam kehidupannya. Belajar pemecahan masalah mengacu pada proses mental individu dalam menghadapi suatu masalah untuk selanjutnya menemukan cara mengatasi masalah itu melalui proses berpikir yang sistematis dan cermat.

Salah satu langkah pemecahan masalah adalah langkah menurut Polya (Tim MKPBM, 2001: 84). Langkah-langkah dalam pembelajaran pemecahan masalah menurut Polya ada 4, yaitu: (1) memahami masalah, (2) menentukan rencana strategi pemecahan masalah, (3) menyelesaikan strategi penyelesaian masalah, dan (4) memeriksa kembali jawaban yang diperoleh. Pembelajaran ini dimulai dengan pemberian masalah, kemudian siswa berlatih memahami,

menyusun strategi dan melaksanakan strategi sampai dengan menarik kesimpulan. Guru membimbing siswa pada setiap langkah pemecahan masalah dengan memberikan pertanyaan yang mengarah pada konsep.

Dalam hal ini peneliti menggunakan metode pemecahan masalah menurut Polya. Peneliti mengharapkan metode pembelajaran ini dapat mengembangkan kemampuan pemecahan masalah siswa dan dapat meningkatkan prestasi belajar siswa dalam pelajaran matematika menjadi lebih baik.

Berdasarkan hasil observasi peneliti dan hasil wawancara dengan guru mata pelajaran matematika di SMP Negeri 6 Banjarmasin yaitu bapak H.M.Zaini,M.Pd diperoleh keterangan bahwa siswa cenderung menghafal rumus, bukan memahami konsep. Dalam menghadapi soal siswa langsung berpikir untuk menggunakan algoritma atau rumus, bahkan rumus yang lebih singkat akan lebih digunakan daripada cara lain yang lebih panjang. Jadi hasil atau jawaban lebih dipentingkan, sedangkan proses diabaikan baik itu disengaja atau tidak disengaja. Selain itu, guru masih kurang tepat dalam menerapkan metode pembelajaran yang membuat siswa kurang tertarik untuk menyelesaikan suatu masalah matematika.

Adapun tujuan dalam penelitian ini yaitu: (1) untuk mengetahui kemampuan siswa SMP dalam memecahkan masalah matematika dengan menggunakan metode pemecahan masalah menurut Polya, dan (2) untuk mengetahui perbedaan hasil belajar siswa SMP dalam pembelajaran matematika sebelum dan sesudah diberikan pembelajaran menggunakan metode pemecahan masalah menurut Polya

Pada hakikatnya, program pembelajaran bertujuan tidak hanya memahami dan menguasai apa dan bagaimana suatu terjadi, tetapi juga memberi pemahaman dan penguasaan tentang “mengapa hal itu terjadi?”. Berdasarkan pada permasalahan tersebut, maka pembelajaran pemecahan masalah menjadi sangat penting untuk diajarkan.

Pada dasarnya tujuan akhir pembelajaran adalah menghasilkan siswa yang memiliki pengetahuan dan keterampilan dalam memecahkan masalah yang dihadapi kelak di masyarakat. Untuk menghasilkan siswa yang memiliki kompetensi yang andal dalam pemecahan masalah, maka diperlukan serangkaian strategi pembelajaran pemecahan masalah (Wena, 2013: 52).

Menurut Hardini dan Puspitasari (2012: 86) pemecahan masalah dipandang sebagai suatu proses untuk menemukan kombinasi dari sejumlah aturan yang dapat diterapkan dalam upaya mengatasi situasi yang baru.

Pemecahan masalah tidak sekedar sebagai bentuk kemampuan menerapkan aturan-aturan yang telah dikuasai melalui kegiatan-kegiatan belajar terdahulu, melainkan lebih dari itu, merupakan proses untuk mendapatkan aturan pada tingkat yang lebih tinggi.

Kemampuan pemecahan masalah sangat penting artinya bagi siswa dan masa depannya. Para ahli pembelajaran sependapat bahwa kemampuan pemecahan masalah dalam batas-batas tertentu, dapat dibentuk melalui bidang studi dan disiplin ilmu yang diajarkan (Wena, 2013: 53).

Terdapat banyak interpretasi tentang pemecahan masalah dalam matematika. Diantaranya pendapat Polya (1985) yang banyak dirujuk pemerhati matematika. Polya mengartikan pemecahan masalah sebagai suatu usaha mencari jalan keluar dari suatu kesulitan guna mencapai suatu tujuan yang tidak begitu segera dapat dicapai.

Pemecahan masalah merupakan salah satu tipe keterampilan intelektual yang menurut Gagne, dkk (1992) lebih tinggi derajatnya dan lebih kompleks dari tipe keterampilan intelektual lainnya. Gagne, dkk (1992) berpendapat bahwa dalam menyelesaikan pemecahan masalah diperlukan aturan kompleks atau aturan tingkat tinggi dan aturan tingkat tinggi dapat dicapai setelah menguasai aturan dan konsep terdefinisi. Demikian pula aturan dan konsep terdefinisi dapat dikuasai jika ditunjang oleh pemahaman konsep konkrit. Setelah itu untuk memahami konsep konkrit diperlukan keterampilan dalam membedakan.

Oleh karena itu dengan mengacu pada pendapat-pendapat di atas, maka pemecahan masalah dapat dilihat dari berbagai pengertian. Yaitu, sebagai upaya mencari jalan keluar yang dilakukan dalam mencapai tujuan. Juga memerlukan kesiapan, kreativitas, pengetahuan dan kemampuan serta aplikasinya dalam kehidupan sehari-hari. Di samping itu pemecahan masalah merupakan persoalan- persoalan yang belum dikenal serta mengandung pengertian sebagai proses berfikir tinggi dan penting dalam pembelajaran matematika.

Pemecahan masalah merupakan kemampuan dasar yang harus dikuasai oleh siswa. Tuntutan akan kemampuan pemecahan masalah dipertegas secara eksplisit dalam kurikulum tersebut yaitu, sebagai kompetensi dasar yang harus dikembangkan dan diintegrasikan pada sejumlah materi yang sesuai.

Pentingnya kemampuan penyelesaian masalah oleh siswa dalam matematika ditegaskan juga oleh Branca (1980), yaitu :

(1) Kemampuan menyelesaikan masalah merupakan tujuan umum pengajaran matematika.

(2) Penyelesaian masalah yang meliputi metode, prosedur dan strategi merupakan proses inti dan utama dalam kurikulum matematika .

(3) Penyelesaian masalah merupakan kemampuan dasar dalam belajar matematika. Pandangan bahwa kemampuan menyelesa masalah merupakan tujuan umum pengajaran matematika, mengandung pengertian bahwa matematika dapat membantu dalam memecahkan persoalan baik dalam pelajaran lain maupun dalam kehidupan sehari-hari. Oleh karenanya kemampuan pemecahan masalah ini menjadi tujuan umum pembelajaran matematika.

Pandangan pemecahan masalah sebagai proses inti dan utama dalam kurikulum matematika, berarti pembelajaran pemecahan masalah lebih mengutamakan proses dan strategi yang dilakukan siswa dalam menyelesaikannya daripada hanya sekedar hasil. Sehingga keterampilan proses dan strategi dalam memecahkan masalah tersebut menjadi kemampuan dasar dalam belajar matematika.

Memecahkan suatu masalah merupakan suatu aktivitas dasar bagi manusia. Kenyataan menunjukkan bahwa sebagian besar kehidupan manusia berhadapan dengan masalah-masalah. Oleh sebab itu kita perlu mencari penyelesaiannya. Jika gagal dengan satu cara dalam menyelesaikan masalah maka harus mencoba dengan cara lain untuk menyelesaikan masalah tersebut dan harus berani menghadapi masalah untuk menyelesaikannya.

Berdasarkan teori belajar yang dikemukakan Gagne bahwa keterampilan intelektual tingkat tinggi dapat dikembangkan melalui pemecahan masalah. Pemecahan masalah merupakan tipe belajar paling tinggi dari delapan tipe belajar yang dikemukakan Gagne, yaitu : belajar, isyarat, stimulus respon, rangkaian gerak, rangkaian verbal, membedakan, pembentukan konsep, pembentukan aturan, dan pemecahan masalah (Tim MKPBM, 2001: 83).

Menurut Polya dalam Tim MKPBM Jurusan Matematika (2001: 84) disebutkan bahwa solusi soal pemecahan masalah memuat empat langkah fase penyelesaian, yaitu : memahami masalah, merencanakan penyelesaian, menyelesaikan masalah sesuai rencana, dan melakukan pengecekan kembali terhadap semua langkah yang telah dikerjakan. Fase pertama adalah memahami masalah. Tanpa adanya pemahaman terhadap masalah yang diberikan, siswa tidak mungkin mampu menyelesaikan masalah tersebut dengan benar. Fase kedua adalah menyelesaikan masalah sesuai rencana. Kemampuan menyelesaikan fase kedua ini sangat tergantung pada pengalaman siswa dalam menyelesaikan masalah. Semakin bervariasi pengalaman mereka, ada kecenderungan siswa lebih kreatif

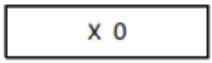
dalam menyusun rencana penyelesaian suatu masalah, dilanjutkan penyelesaian masalah sesuai rencana yang dianggap paling tepat. Langkah terakhir dari proses penyelesaian masalah menurut Polya adalah melakukan pengecekan atas apa yang telah dilaksanakan mulai dari fase pertama sampai fase penyelesaian ketiga.

Langkah-langkah menurut Polya meliputi: menyajikan masalah dalam bentuk yang lebih jelas, menyatakan masalah dalam bentuk yang lebih operasional, menyusun hipotesis- hipotesis kerja dan prosedur kerja yang diperkirakan baik, mengetes hipotesis dan melakukan kerja untuk memperoleh hasilnya, mengecek kembali hasil yang sudah diperoleh. Langkah-langkah menurut Polya pada dasarnya adalah belajar metode-metode ilmiah atau berpikir secara sistematis, logis, dan teratur secara teliti. Tujuannya adalah untuk memperoleh kemampuan kecakapan dalam memecahkan masalah secara rasional, lugas dan tuntas.

## II. METODE

Penelitian ini dilaksanakan dengan metode "quasi experiment" (eksperimen semu) dengan menerapkan bentuk One-Shot Case Study. Desain ini menggunakan struktur desain:

Dimana X merupakan perlakuan yang diberikan dan dilihat pengaruhnya dalam eksperimen tersebut, sedangkan 0 adalah tes atau observasi yang dilakukan setelah perlakuan diberikan. Dari tes atau observasi inilah diambil kesimpulan (Arikunto, 2006: 85).




Penelitian ini dilaksanakan di SMP Negeri 6 Banjarmasin pada bulan November 2013, dengan populasinya adalah siswa kelas VIII SMP Negeri 6 Banjarmasin tahun pelajaran 2013-2014 sebanyak 252 orang yang terdiri dari 8 kelas. Sedangkan sampel penelitian adalah siswa kelas VIII B SMP Negeri 6 Banjarmasin.

Teknik pengumpulan data yang digunakan dalam penelitian ini adalah wawancara, dokumentasi, dan tes. Wawancara digunakan untuk mengetahui keadaan sekolah dan keadaan kelas serta siswa yang ingin diteliti. Wawancara dilakukan dengan guru atau orang yang berhubungan dengan sekolah tempat penelitian. Sedangkan dokumentasi dilakukan untuk memperoleh data dalam pelaksanaan pembelajaran matematika. Data yang diambil berupa arsip/ dokumen sekolah yang diperlukan untuk melengkapi data penelitian.Sementara

itu bentuk tes yang digunakan berupa tes uraian (essay) dengan materi Sistem Persamaan Linear Dua Variabel (SPLDV) pada setiap akhir pembelajaran.

Kemampuan pemecahan masalah yang diamati yaitu (1) kemampuan memahami masalah, (2) kemampuan membuat rencana pemecahan masalah, (3) kemampuan melakukan rencana, dan (4) kemampuan memeriksa kembali hasil penyelesaian masalah. Panduan skor pemecahan masalah adalah sebagai berikut:

Tabel 1 Panduan Pemberian Skor Pemecahan Masalah Menurut Polya

| Aspek yang dinilai | Skor | Keterangan |
|---|---|---|
| Memahami Masalah | 0 | Salah menginterpretasikan / salah sama sekali.<br>(Tidak menyebutkan/menuliskan apa yang diketahui dan apa yang ditanyakan dari soal) |
| | 1 | Salah menginterpretasikan sebagian soal, mengabaikan kondisi soal.<br>(Menyebutkan/menuliskan apa yang diketahui dan apa yang ditanyakan dari soal dengan kurang tepat) |
| | 2 | Memahami masalah soal selengkapnya.<br>(Menyebutkan/menuliskan apa yang diketahui dan apa yang ditanyakan dari soal dengan tepat) |
| Membuat Rencana Pemecahan Masalah | 0 | Tidak ada rencana, membuat rencana yang tidak relevan<br>(Tidak menyajikan urutan langkah penyelesaian sama sekali) |
| | 1 | Membuat rencana pemecahan yang tidak dapat dilaksanakan, sehingga rencana itu tidak mungkin dapat dilaksanakan.<br>(Menyajikan urutan langkah penyelesaian yang mustahil dilakukan) |
| | 2 | Membuat rencana dengan benar tetapi salah dalam hasil/tidak ada hasil.<br>(Menyajikan urutan langkah penyelesaian yang benar tetapi mengarah pada jawaban yang salah) |
| | 3 | Membuat rencana yang benar tetapi belum lengkap<br>(Menyajikan urutan langkah penyelesaian yang benar tetapi kurang lengkap) |
| | 4 | Membuat rencana sesuai dengan prosedur dan mengarahkan pada solusi yang benar<br>(Menyajikan urutan langkah penyelesaian yang benar tetapi mengarah pada jawaban yang benar) |
| Melakukan Rencana/ Perhitungan | 0 | Tidak melakukan perhitungan. |
| | 1 | Melaksanakan prosedur yang benar dan mungkin menghasilkan jawaban benar tapi salah perhitungan. |
| | 2 | Melakukan proses yang benar dan mendapatkan hasil yang benar |
| Memeriksa Kembali Hasil | 0 | Tidak ada pemeriksaan atau tidak ada keterangan lain |
| | 1 | Ada pemeriksaan tetapi tidak tuntas |
| | 2 | Pemeriksaan dilaksanakan untuk melihat kebenaran proses |

(Aryan, 2002)

Data yang diperoleh merupakan nilai kognitif hasil kemampuan pemecahan masalah siswa yang berupa nilai evaluasi akhir program pembelajaran dan nilai ulangan siswa sebelum masalah menurut Polya. Hasil kemampuan pemecahan masalah diinterpretasikan pada tabel sebagai berikut:

Tabel 2 Interpretasi Kemampuan Pemecahan Masalah

| No. | Nilai | Kriteria |
|---|---|---|
| 1. | 80,0-100 | Baik Sekali |
| 2. | 65-79,9 | Baik |
| 3. | 55-64,9 | Cukup |
| 4. | 40-54,9 | Kurang |
| 5. | 0-39,9 | Kurang Sekali |

(Adaptasi Arikunto, 2009: 245)

Sementara itu, kualifikasi hasil kemampuan pemecahan masalah yang dicapai oleh siswa dapat diketahui melalui nilai rata-rata yang dirumuskan dengan:

$$\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

(Sudjana, 2005: 67)

Keterangan :

$\bar{x}$ = nilai rata-rata (mean)

$\Sigma f_i x_i$ = jumlah hasil perkalian antara data dengan frekuensinya

$\Sigma f_i$ = jumlah data atau sampel

Selanjutnya nilai rata-rata hasil belajar siswa sebelum dan sesudah diberikan metode pembelajaran pemecahan masalah menurut Polya diinterpretasikan pada tabel sebagai berikut:

Tabel 3 Interpretasi Predikat Hasil Belajar Siswa

| No. | Nilai | Kriteria |
|---|---|---|
| 1. | 95,0-100 | Istimewa |
| 2. | 80,0-94,9 | Amat baik |
| 3. | 65,0-79,9 | Baik |
| 4. | 55,0-64,9 | Cukup |
| 5. | 40,1-54,9 | Kurang |
| 6. | 0-40,0 | Amat kurang |

(Tim Depdiknas, 2004)

Nilai kemampuan pemecahan masalah dan hasil belajar selanjutnya dianalisis menggunakan uji beda, yang mana sebelumnya dilakukan uji pendahuluan berupa uji normalitas dan uji homogenitas. Data yang berdistribusi normal dianalisis menggunakan uji t, sementara itu data yang tidak berdistribusi normal dianalisis menggunakan uji Mann-Whitney.

(Tim Depdiknas, 2004)

## III. HASIL DAN PEMBAHASAN

Analisis nilai kemampuan pemecahan masalah siswa pada penelitian ini dilihat berdasarkan kualifikasi kurang sekali, kurang, cukup, baik, dan baik sekali. Data distribusi frekuensi nilai kemampuan pemecahan masalah siswa pada semua pertemuan, diperoleh kesimpulan sebagai berikut:

Tabel 4 Kualifikasi Nilai Kemampuan Pemecahan Masalah Indikator 1

| Nilai | Kualifikasi | Pertemuan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | | II | | III | | IV | | V | |
| | | f | % | f | % | f | % | f | % | f | % |
| 80,0-100 | Baik Sekali | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 65-79,9 | Baik | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 26,7 |
| 55-64,9 | Cukup | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40-54,9 | Kurang | 27 | 90 | 25 | 83,3 | 28 | 93,3 | 29 | 96,7 | 22 | 73,3 |
| 0-39,9 | Kurang Sekali | 3 | 10 | 5 | 16,7 | 2 | 6,7 | 1 | 3,3 | 0 | 0 |
| Rata-Rata | | 45 | | 45,8 | | 47,5 | | 48,3 | | 56,7 | |

Keterangan:
f = frekuensi/banyak siswa
(%) = persentase

Nilai rata-rata indikator 1 pertemuan pertama berada pada kualifikasi kurang, kemudian pada pertemuan kedua kualifikasi tetap berada pada kurang, pada pertemuan ketiga dan keempat nilai rata-rata meningkat tapi masih dalam kualfikasi yang sama dan berada pada kualifikasi cukup.

Dari hasil analisis data diketahui bahwa ada perbedaan yang signifikan antara pertemuan 1 dengan pertemuan 5, artinya indikator 1 yaitu kemampuan memahami masalah berkembang secara signifikan.

Tabel 5 Kualifikasi Nilai Kemampuan Pemecahan Masalah Indikator 2

| Nilai | Kualifikasi | Pertemuan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | | II | | III | | IV | | V | |
| | | f | % | f | % | f | % | f | % | f | % |
| 80,0-100 | Baik Sekali | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 65-79,9 | Baik | 17 | 56,7 | 24 | 80 | 27 | 90 | 27 | 90 | 29 | 96,7 |
| 55-64,9 | Cukup | 0 | 0 | 6 | 20 | 0 | 0 | 2 | 6,7 | 1 | 3,3 |
| 40-54,9 | Kurang | 13 | 43,3 | 0 | 0 | 2 | 6,7 | 1 | 3,7 | 0 | 0 |
| 0-39,9 | Kurang Sekali | 0 | 0 | 0 | 0 | 1 | 3,3 | 0 | 0 | 0 | 0 |
| Rata-Rata | | 64,2 | | 72,5 | | 73,3 | | 73,3 | | 74,6 | |

Keterangan:
f = frekuensi/banyak siswa
(%) = persentase

Nilai rata-rata indikator 2 pertemuan pertama berada pada kualifikasi cukup, kemudian pada pertemuan kedua kualifikasi berubah menjadi baik, pada pertemuan ketiga dan keempat nilai rata-ratanya sama berada pada kualifikasi baik dan nilai rata-rata indikator masih berada pada kualifikasi baik.

Dari hasil analisis data diketahui bahwa ada perbedaan yang signifikan antara pertemuan 1 dengan pertemuan 5, artinya indikator 2 yaitu kemampuan membuat rencana pemecahan masalah berkembang secara signifikan.

Tabel 6 Kualifikasi Nilai Kemampuan Pemecahan Masalah Indikator 3

| Nilai | Kualifikasi | Pertemuan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | | II | | III | | IV | | V | |
| | | f | % | f | % | f | % | f | % | f | % |
| 80,0-100 | Baik Sekali | 18 | 60 | 13 | 43,3 | 21 | 70 | 24 | 80 | 23 | 76,7 |
| 65-79,9 | Baik | 0 | 0 | 15 | 50 | 3 | 10 | 4 | 13,3 | 7 | 23,3 |
| 55-64,9 | Cukup | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40-54,9 | Kurang | 12 | 40 | 2 | 6,7 | 5 | 16,7 | 2 | 6,7 | 0 | 0 |
| 0-39,9 | Kurang Sekali | 0 | 0 | 0 | 0 | 1 | 3,3 | 0 | 0 | 0 | 0 |
| Rata-Rata | | 80 | | 84,2 | | 86,7 | | 93,3 | | 94,2 | |

Nilai rata-rata indikator 3 pertemuan pertama berada pada kualifikasi baik sekali, kemudian pada pertemuan kedua rata-ratanya lebih tinggi meskipun kualifikasi masih baik sekali, pada pertemuan ketiga rata-rata juga lebih tinggi namun masih berada pada kualifikasi baik pertemuan kelima mengalami peningkatan rata- rata yang berada pada kualifikasi baik sekali.

Dari hasil analisis data diketahui bahwa ada perbedaan yang signifikan antara pertemuan 1 dengan pertemuan 5, artinya indikator 3 yaitu kemampuan melakukan rencana/perhitungan berkembang secara signifikan.

Tabel 7 Kualifikasi nilai kemampuan pemecahan masalah indikator 4

| Nilai | Kualifikasi | Pertemuan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | | II | | III | | IV | | V | |
| | | f | % | f | % | f | % | f | % | f | % |
| 80,0-100 | Baik Sekali | 0 | 0 | 3 | 10 | 4 | 13,3 | 6 | 20 | 11 | 36,7 |
| 65-79,9 | Baik | 0 | 0 | 3 | 10 | 6 | 20 | 8 | 26,7 | 8 | 26,7 |
| 55-64,9 | Cukup | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40-54,9 | Kurang | 9 | 30 | 11 | 36,7 | 8 | 26,7 | 9 | 30 | 7 | 23,3 |
| 0-39,9 | Kurang Sekali | 21 | 70 | 13 | 43,3 | 12 | 40 | 7 | 23,7 | 4 | 13,3 |
| Rata-Rata | | 15 | | 41,7 | | 47,5 | | 59,2 | | 70 | |

Keterangan: f = frekuensi/banyak siswa (%) = persentase

Nilai rata-rata indikator 4 pertemuan pertama berada pada kualifikasi kurang sekali, kemudian pada pertemuan kedua kualifikasi berubah menjadi kurang, pada pertemuan ketiga rata-rata lebih tinggi namun masih berada pada kualifikasi kurang, pada pertemuan keempat rata- rata lebih tinggi lagi menjadi cukup dan pada pertemuan kelima kualifikasi lebih tinggi lagi menjadi baik.

Dari hasil analisis data diketahui bahwa ada perbedaan yang signifikan antara pertemuan 1 dengan pertemuan 5, artinya indikator 4 yaitu kemampuan memeriksa kembali hasil berkembang secara signifikan.

Hasil Belajar Siswa

Berdasarkan data hasil belajar keseluruhan dari sebelum dan sesudah diberikan metode pemecahan masalah menurut Polya, kesimpulannya sebagaimana pada tabel berikut:

Tabel 8 Kualifikasi nilai hasil belajar siswa

| Nilai | Kualifikasi | Perlakuan | | | |
|---|---|---|---|---|---|
| | | Sebelum | | Sesudah | |
| | | f | % | f | % |
| 95,0-100 | Istimewa | 5 | 16,7 | 13 | 43,3 |
| 80,0-94,9 | Amat Baik | 17 | 56,7 | 13 | 43,3 |
| 65,0-79,9 | Baik | 7 | 23,3 | 3 | 10 |
| 55,0-64,9 | Cukup | 0 | 0,0 | 1 | 3,3 |
| 40,1-54,9 | Kurang | 0 | 0,0 | 0 | 0,0 |
| 0-40,0 | Amat Kurang | 1 | 3,3 | 0 | 0,0 |
| Rata-Rata | | 83,6 | | 90,5 | |

Keterangan:
f = frekuensi/banyak siswa
(%) = persentasi

Nilai rata-rata hasil belajar siswa sebelum diberikan metode pemecahan masalah menurut Polya berada pada kualifikasi amat baik, sama halnya pada sesudah diberikan metode pemecahan masalah menurut Polya berada pada kualifikasi amat baik. Namun bisa dilihat bahwa rata-rata sesudah diberikan metode tersebut lebih tinggi daripada sebelum diberikan metode meskipun berada pada kualifikasi yang sama.

Berdasarkan hasil analisis data maka dapat disimpulkan bahwa ada perbedaan yang signifikan antara hasil belajar matematika sebelum dan sesudah diberikan metode pembelajaran dengan menggunakan metode pemecahan masalah menurut Polya.

## IV. SIMPULAN DAN SARAN

Simpulan

Berdasarkan hasil penelitian yang telah dilakukan dapat diambil beberapa kesimpulan sebagai berikut:

(1) Terdapat 4 indikator kemampuan pemecahan masalah yaitu memahami masalah, membuat rencana pemecahan masalah, melakukan rencana/ perhitungan, dan memeriksa kembali hasil. Setiap indikator berkembang secara signifikan dari pertemuan pertama sampai pertemuan kelima.

Artinya dengan metode pemecahan masalah menurut Polya dapat mengembangkan kemampuan pemecahan masalah siswa.

(2) Terdapat perbedaan yang signifikan antara sebelum diberikan metode pemecahan masalah menurut Polya dan sesudah diberikan metode pemecahan masalah menurut Polya. Nilai rata-rata hasil belajar meningkat dari 83,6 menjadi 90,5. Artinya terdapat perbedaan hasil belajar dari metode pemecahan masalah menurut Polya terhadap kemampuan pemecahan masalah matematis siswa. Penggunaan metode pemecahan masalah menurut Polya dapat membuat hasil belajar siswa menjadi lebih baik.

Saran

Berdasarkan kesimpulan yang diperoleh dalam peneltian ini, maka disampaikan beberapa saran yaitu:

(1) Diharapkan agar siswa lebih rajin belajar untuk mengembangkan kemampuan pemecahan masalahnya.

(2) Guru bidang studi matematika dapat menerapkan metode pemecahan masalah menurut Polya sebagai alternatif dan variasi dalam pembelajaran matematika untuk meningkatkan kemampuan pemecahan masalah siswa

(3) Penggunaan metode pemecahan masalah menurut Polya hendaknya memperhatikan waktu pembelajaran, karena dalam penerapannya metode ini membutuhkan waktu yang relatif panjang untuk mengembangkan kemampuan yang dimiliki siswa.

(4) Diharapkan ada penelitian lebih lanjut berkenaan dengan hasil penelitian ini di tempat dan dengan pokok bahasan berbeda, mengingat berbagai keterbatasan yang ada dalam penelitian ini.

## DAFTAR PUSTAKA

Arikunto, S. 2006. *Prosedur Penelitian Suatu Pendekatan Praktik*. Rineka Cipta, Jakarta.

Arikunto, S. 2009. *Dasar-Dasar Evaluasi Pendidikan*. Bumi Aksara, Jakarta.

Aryan, Bambang. 2002. *Kemampuan Pemecahan Masalah Matematika Siswa dengan Strategi Heuristik*. Tesis UPI, Bandung.

BSNP. 2006. *Standar Isi, Standar Kompetensi dan Kompetensi Dasar SMP/ MTs*. Badan Standar Nasional Pendidikan, Jakarta.

Hamdani. 2011. *Strategi Belajar Mengajar*. Pustaka Setia, Bandung.

Hardini Isriani & Dewi Puspitasari. 2012. *Strategi Pembelajaran Terpadu : Teori, Konsep & Implementasi*. Familia, Yogyakarta.

Polya, G. 1985. *How to Solve It. A New Aspect of Mathematical Method*. Princeton University Press, Princeton, New Jersey.

Rusman. 2010. *Model-Model Pembelajaran*. Rajawali Pers, Jakarta.

Sanjaya. 2013. *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*. Kencana, Jakarta.

Slameto. 2010. Belajar dan Faktor-Faktor yang Memperngaruhinya. Rineka Cipta, Jakarta.

Sudijono, A. 2012. *Pengantar Statistik Pendidikan*. Rajagrafindo Persada, Jakarta.

Sudjana. 2002. *Metoda Statistika*. Tarsito, Bandung.

Sugiyono. 2010. *Statistika untuk Penelitian*. Alfabeta, Bandung.

Suprijono. 2013. Cooperative Learning: Teori & Aplikasi PAIKEM. Pustaka Pelajar, Yogyakarta.

Syah, M. 2004. *Psikologi Belajar*. PT. Raja Grafindo Persada, Jakarta.

Tim Dosen Jurusan Pendidikan MIPA FKIP – Unlam, Banjarmasin. 2012. *Petunjuk Penulisan Karya Ilmiah*. Jurusan PMIPA FKIP – Unlam, Banjarmasin.

Tim MKPBM. 2001. *Strategi Belajar Mengajar Kontempore*r. Universitas Pendidikan Indonesia (UPI), Bandung.

Trianto. 2008. *Mendesain Pembelajaran Kontekstual Di Kelas*. Cerdas Pustaka, Jakarta.

Usman, H., & Purnomo, S. A. 2011. *Pengantar Statistika*. Bumi Aksara, Jakarta.

Usman, U., dan L. Setiawati. 2001. *Upaya Optimalisasi Kegiatan Belajar Mengajar*. PT. Remaja Rosdakarya, Bandung.

Wena, Made. 2013. *Strategi Pembelajaran Inovatif Kontemporer*. Bumi Aksara, Jakarta.

# 22. Enhanced mechanical and physical properties of starch foam from the combination of water hyacinth fiber (Eichhornia crassipes) and polyvinyl alcohol

Agung Nugroho, Dessy Maulidya Maharani, Agung Cahyo Legowo, Sutarto Hadi, Febriani Purba

Lambung Mangkurat University, Banjarbaru, Indonesia.

**ABSTRACT**

Water hyacinth (Eichhornia crassipes (Mart.) Solms.) is considered an environmental threat due to its rapid growth and spread. Various studies have utilized water hyacinth fiber (WHF) as a reinforcement to strengthen the mechanical properties of biocomposites. A previous study reported that adding 5% of WHF improves the mechanical properties of the starch foam. The effect of applying a higher concentration of WHF with a combination of polyvinyl alcohol (PVA) on the properties of the starch foam is still unclear. This study investigates the effects of the addition of various concentrations of WHF, with and without polyvinyl alcohol, on the physical and mechanical properties of the starch foam. The foams were produced through a baking process with a thermopressing machine at lower and upper mold temperatures of 170 ?C and 180 ?C for 100 s. Five different WHF concentrations were tested, namely 0%, 5%, 10%, 15%, and 20%, with and without the addition of 10% polyvinyl alcohol. The products were then tested for their characteristics, including mechanical (compressibility) strength, water absorption, morphological structure, density, color appearance, and biodegradability. The results showed that the addition of 10% WHF improved the physical and mechanical properties of the foams. However, over-supplementation (15% or more) had some weakening effects, such as lowering the compressibility strength, increasing the water absorption, and darkening the physical appearance of the products. The addition of 10%

PVA also contributed positively to their compressibility, density, and water absorption characteristics.

Keywords: Biocomposite, Biodegradable foam, Lignocellulosic biomass, Reinforcement

## 1. INTRODUCTION

Over the years, there has been an increase in people's dependence on plastics (Diyana et al., 2021). Furthermore, its annual global production has increased by 230 times since 1950. A production rate of 350 Mt/year was recorded in 2020 (Bucknall, 2020) , where 34% of this number was contributed by Asian countries (Liang et al., 2021). Plastic waste has a huge negative impact on environmental sustainability, especially the aquatic ecosystem and human health (Mohammed et al., 2021). Several studies have reported that 11% of these wastes are disposed into the aquatic ecosystems (Borrelle et al., 2020). Consequently, there have been several efforts to reduce plastic pollution, including replacing synthetic chemicals with organic materials, such as cellulose and starch.

Expanded polystyrene (EPS) is one of the most widely used plastics, and it accounts for more than 6% of all plastics (Hidalgo-Crespo et al., 2020). It is also a superior packaging material due to its economical price, rigidity, lightweight, water resistance, chemical stability, shock resistance, thermal insulation, and flexibility in molding. However, its polymers are not easily degraded naturally due to their incredible stability. Hence, several natural polymers have been investigated as alternatives to produce degradable EPS-like foams (Engel et al., 2019; Glenn et al., 2001; Iriani et al., 2015; Kaisangsri et al., 2019; Machado et al., 2020; Mello and Mali, 2014; Salgado et al., 2008; Vargas-Torres et al., 2017; Vercelheze et al., 2012).

Biodegradable foams are often produced by baking a moisture dough containing starch and fiber. They are formed when the starch is gelatinized and inflated into a hollow object by vapor. However, the starchbased foam has low-quality mechanical properties and decreased water resistance due to the presence of hydrophilic starch as the main constructor. Several efforts have been made to improve its properties by modifying the composition and fiber structure (Jiang et al., 2020).

Water hyacinth (Eichhornia crassipes (Mart.) Solms.) is an aquatic

plant, and it is a potential source of fiber. In addition to its abundant availability and speedy growth, its fibers have high-quality mechanical properties (Ajithram et al., 2021). However, the overgrowth of water hyacinth has a negative impact on the aquatic ecosystem. As a result, efforts are being made to mitigate the plant's impact on the environment and increase its economic value. Various studies have explored the use of its lignocellulosic fibers for biocomposite materials to strengthen their physical and mechanical properties (Abral et al., 2014; Ajithram et al., 2021; Chaireh et al., 2020; Jirawattanasomkul et al., 2021; Sukhawipat et al., 2021; Syafri et al., 2019).

The previous study (Chaireh et al., 2020) reported the effects of adding 5% water hyacinth powder (250 µm in particle size) on the mechanical properties of the starch foam. However, there is a lack of information about the effects of adding a larger size of water hyacinth fiber (WHF) at a higher concentration with a shorter baking time. In addition, there is no report about the effect of blending the WHF with polyvinyl alcohol (PVA) on the mechanical properties of the starch-based foam. Therefore, this study aims to determine the physical and mechanical properties of starch-based foam produced by adding the larger size of WHF at a concentration of up to 20% along with and without the addition of 10% PVA. Application of the larger size of fibers at a higher concentration combined with shorter baking time may reduce the production cost of starch-based foams.

## II. MATERIAL AND METHODS

### 2.1. Material

The brand of cassava starch (Manihot esculenta) used in this research was the Rose starch produced by PT Budi Acid Jaya Inc., Lampung, Indonesia. The Polyvinyl alcohol powder was PVA 2488 (Shuangxin Co., Ltd, China, purity > 93%). Water hyacinths were collected from Martapura River in Banjarmasin City, after which they were cut and collected for their petiole parts. Subsequently, the samples were cut into pieces with 10 cm length and then dried under the sun in a greenhouse for eight days. The sun-dried cut petioles were dried in an oven at 50 $^0$C for 24 h and then ground and passed through a 600 µm sieve to produce WHF. The production process of the WHF is shown in Fig. 1.


2.2. Foam production

The starch foam was produced by baking the dough using a thermopressing machine containing two heated steel molds (male-female). The molds were equipped with a hydraulic system to enable the upper (male) and lower molds (female) to meet precisely. Meanwhile, the dough was prepared by mixing cassava starch, WHF (solid phase), and PVA-water gel on a stand mixer (Bosch, MUM48CR1, Bosch Ltd. Inc.) for 10 min at 3000 rpm. The ratio with which the components were mixed was based on the experimental design, as shown in Table 1. The baking process took 100 s, with the lower mold set at 170 ?C and the upper mold set at 180 ?C. After baking, a cup-shaped foam was obtained with a height of 20 mm and a top and bottom diameter of 70 mm and 50 mm, respectively. It was then detached from the mold and cooled for 5 min at room temperature. Before characterization of the physical properties, the foams were stored in a sealed plastic bag at 27 ?C and 75% relative humidity.

**Table 1**
Experimental design (ratio of cassava starch, water hyacinth fiber, and polyvinyl alcohol).

| Experiment | Cassava starch (wt%) | Water hyacinth fiber (wt%) | PVA (wt%) |
|---|---|---|---|
| X1 | 100 | 0 | 0 |
| X2 | 95 | 5 | 0 |
| X3 | 90 | 10 | 0 |
| X4 | 85 | 15 | 0 |
| X5 | 80 | 20 | 0 |
| Y1 | 90 | 0 | 10 |
| Y2 | 85.5 | 4.5 | 10 |
| Y3 | 81 | 9 | 10 |
| Y4 | 76.5 | 13.5 | 10 |
| Y5 | 72 | 18 | 10 |

2.3. Density

The density of the foam was measured using the standard measurement of ASTM D2395 (standard test methods for density of wood and wood-based materials) by comparing the sample weight (g) to the body volume (cm3). The sample was submerged in a tank with a known volume of water and the change in volume of water was recorded as thevolume of the sample.

2.4. Morphological identification

The foam's morphology was identified using a scanning electron microscope (Inspect-S50, FEI Company, USA). The samples were covered with a thin gold layer during the scanning with 20 kV acceleration voltage.

2.5. Mechanical properties

The mechanical properties of foams were determined based on the ASTM D882–02 using a Brookfield CT3 texture analyzer (Brookfield Engineering, MA, USA) equipped with a spherical probe of 18 mm diameter. Furthermore, the compression test was carried out on circleshaped foam samples with a diameter of 45 mm, and the samples were pressed with a 0.5 N load at a speed rate of 1 mm/s.

2.6. Water absorption test

The water absorption was determined based on the steps outlined by ABNT NBR NM ISO 535. Each full-shaped foam sample was weighed and was denoted as initial weight (W0). Subsequently, they were immersed in water to a depth of 10 mm for 60 s, dried using tissue paper, and thenweighed again

as the final weight (W1). The foam's water absorption was calculated as the difference between initial and final weight percentages.

2.7. Biodegradability test

The foam's biodegradability was evaluated by burying samples the culture soil with a pH of 7.84. The culture soil contained 44% organic matter, 0.12% total N, 3.12 ppm P, 1.46 m.e/100 g soil exchangeable K+ ions, and 0.53 mhos/cm salinity. Subsequently, they were packed in a 45 cm × 24 cm x 20 cm plastic box and incubated at 27 ?C for 42 days.

Soil moisture was maintained at 65% by spraying 500 ml of water daily into each soil box. The bottom of the soil box was punctured to allow plant drainage. The foam condition was then observed on days 14, 28, and 42 by identifying the number of residual materials in the testedsamples.

2.8. Color analysis

This analysis was carried out to identify the effect of fiber concentration on the foams' color by considering the value of HSB (hue, saturation, and lightness). Furthermore, the value was identified by plotting the image color of the samples using Adobe Photoshop CC-2019 program. The images were captured with a digital camera (FujiFilm XA3, 24 MP, 16 mm of focal length, f/ 4, ISO speed 200, and 1/125 s of shutter speed) in a 70 cm × 50 cm x 60 cm mini studio box. The lighting condition was then set at 3500 lux, produced by twelve 1.5 watts LED lamps. The distance between the object and the camera was set at 60 cm with a shooting angle of 90?.

2.9. Statistical analysis

A completely randomized design was used with a minimum of ten replicates for each sample of foams for the mechanical properties and color analysis. In contrast, five replicates were used for density and water absorption tests. Analysis of variance (ANOVA) was applied to determine the significance of the treatments. All statistical analyses were performed using statistical software (SPSS version 24). Mean comparisons were performed using Tukey's multiple tests (a = 0.05).

**Table 2**
Chemical and physical properties of the materials.

| Parameter | Cassava starch (%) | Water hyacinth fiber (%) |
|---|---|---|
| Moisture (%) | 12.32 ± 0.08 | 7.47 ± 0.05 |
| Ash content (%) | 0.21 ± 0.021 | 21.50 ± 0.019 |
| Lipid (%) | 0.18 ± 0.011 | 1.61 ± 0.015 |
| Protein (%) | 0.51 ± 0.024 | 7.01 ± 0.021 |
| Carbohydrate (%) | 86.78 ± 0.32 | 62.41 ± 0.28 |
| Crude fiber (%) | 1.12 ± 0.05 | 26.08 ± 0.12 |
| Density (g/cm$^3$) | 0.615 ± 0.01 | 0.285 ± 0.03 |

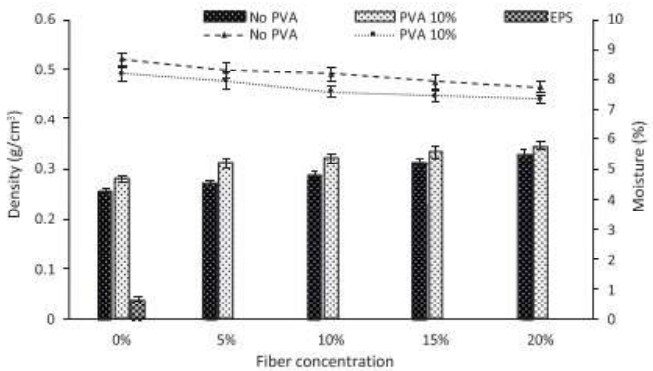



**Fig. 2.** Density and moisture of starch foams differentiated by the WHF concentration and the addition of PVA.

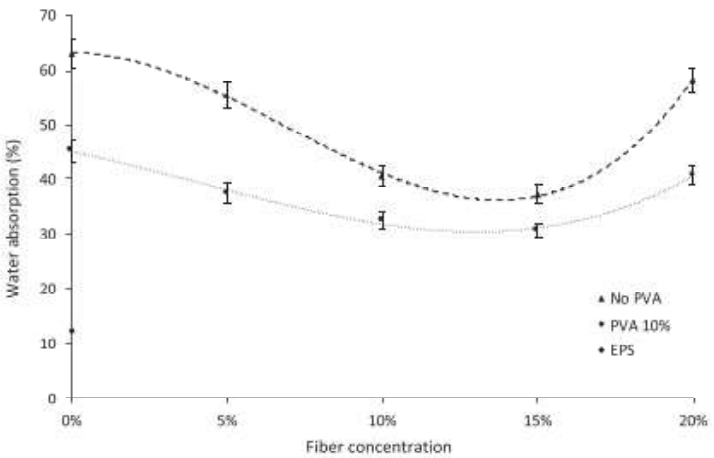



**Fig. 3.** Water absorption of starch foams classified by the WHF concentration and the addition of PVA.

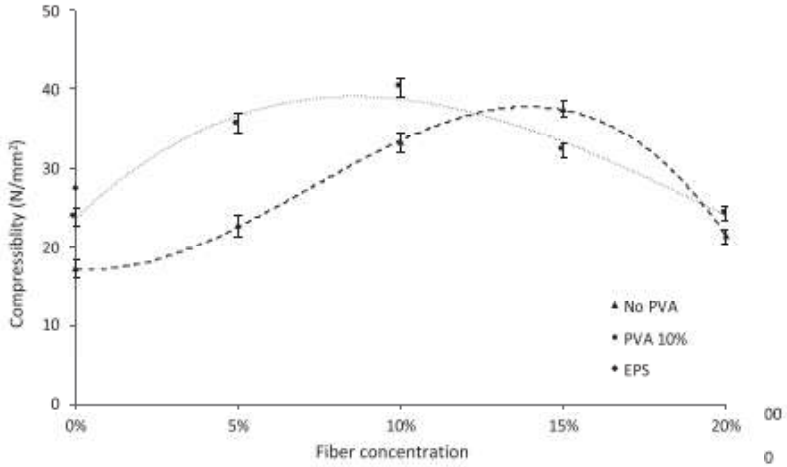



**Fig. 4.** Compressibility of starch foams produced with five different WHF concentrations with and without PVA.

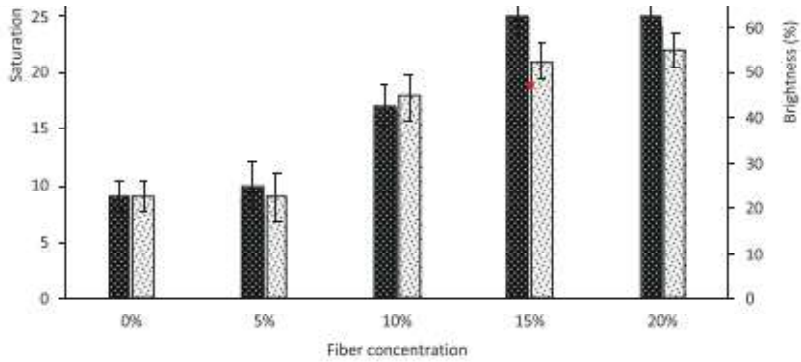




**Fig. 6.** The physical appearance of starch foams produced by five different concentrations of WHF (0, 5, 10, 15, 20%) with (Y) and without (X) the addition of PVA.


**Fig. 7.** Color saturation and brightness of starch foams produced by five different concentrations of WHF (0, 5, 10, 15, 20%) with (Y) and without (X) the addition of PVA.

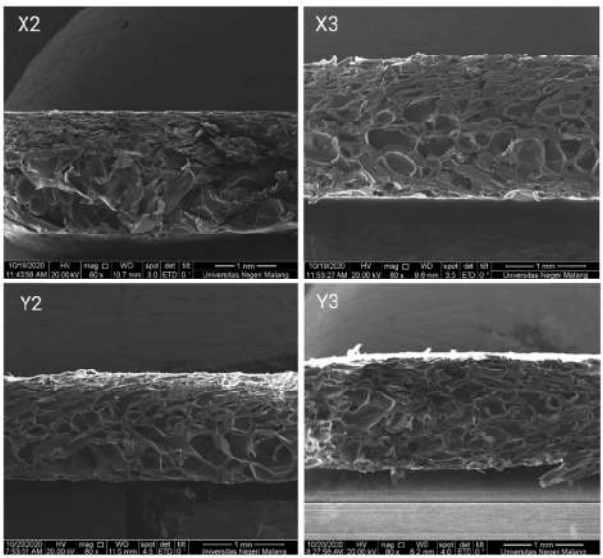



**Fig. 8.** Morphological characteristics (SEM images) of four different formulations of starch foams. X2: 5% of WHF with no PVA; X3: 10% of WHF with no PVA; Y2: 5% of WHF with PVA; Y2: 10% of WHF with PVA.

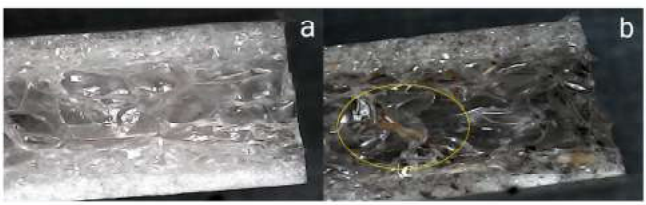



**Fig. 9.** Microscopic photograph of the starch foams. a: foam with 0% of WHF; b: foam with 10% of WHF, the yellow circle indicates the presence of WHF.

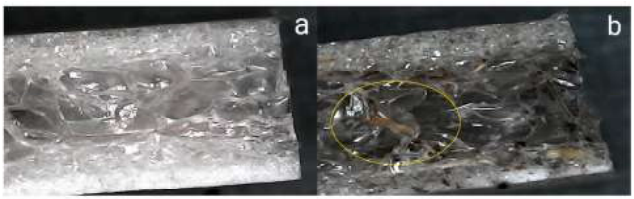



Fig. 9. Microscopic photograph of the starch foams. a: foam with 0% of WHF; b: foam with 10% of WHF, the yellow circle indicates the presence of WHF.

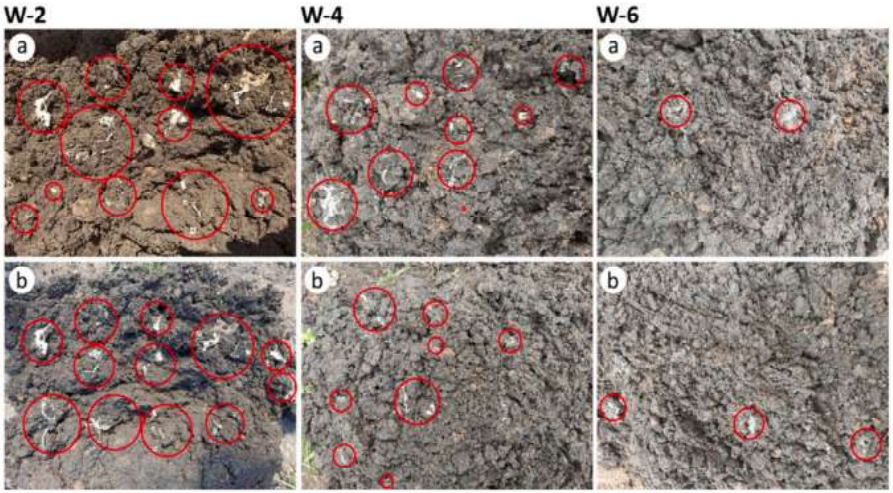



Fig. 10. The physical condition of biofoams during six weeks of biodegradability test. a: biofoams with no PVA; b: biofoams with PV.

## III. RESULTS AND DISCUSSION

### 3.1. Chemical and physical properties of the materials

In this study, cassava starch was selected as the matrix material due to its proper characteristic (Mello and Mali, 2014) for foam production and its economical price and productivity compared with other sources of starch (Jumaidin et al., 2020). The cassava starch and water hyacinth were studied chemically and physically to identify the conditions and formulations to be employed. The result showed that their moisture content was 12.33% and 7.47%, respectively, as shown in Table 2.

### 3.2. Moisture content and density

As the number of WHF increases, the water content of the starch foam decreases due to a reduction in its cassava starch content, as shown in Fig. 2. This was because the cassava starch has higher water content than WHF, as shown in Table 2.

Density is a critical element in determining a material's physical properties because it is directly related to its thermal properties. Highdensity starch foam is an excellent choice as a packaging material due to its high thermal conductivity (Kaewpirom and Sungbuakaew, 2020). Furthermore, the foam produced in this study had a density range of 0.255–0.345 g/cm3 , which increased along with an increase in the WHF ratio and the PVA content (Fig. 2). The samples made from cassava starch, 20% WHF, and PVA had the highest density of 0.345 g/cm3, while others made without WHF and PVA had the lowest value of 0.255 g/cm3. The values obtained from both products were significantly higher than that of the standard expanded polystyrene with a value of 0.04 g/cm3. The starch content of the dough decreased along with an increase in the WHF ratio. It effected the starch's expansivity because WHF is more resistant to swelling and expansion (B´en´ezet et al., 2011). Furthermore, the addition of fibers increased the dough's viscosity by reducing its foaming ability, which led to denser foams (Shogren et al., 1998). The addition of PVA also increased its viscosity by decreasing foam's expansivity, resulting in the formation of denser foams.

3.3. Water absorption

The amount of water absorbed after it was submerged in water was used as an indicator to determine the starch foam quality. Excessive water diffusion must be avoided since it affects the material's internal structure, lowering the quality of the foam. Therefore, starch foam with a low water absorption capacity is preferable.

Fig. 3 shows the total water absorption capacity of foam containing various concentrations of WHF and PVA after 60 s of immersion in water. The water absorption varied between 30.58% and 63.12%. Samples containing PVA had a lower water absorption coefficient than others without PVA because it was more hydrophobic than starch (Sumardiono et al., 2021).

Starch foam with or without PVA has a higher water absorption coefficient than the commercial EPS. The absorption value decreased along with an increase in the concentration of WHF. However, after a 15% decrease due to the addition of WHF, the water absorption began to increase. This phenomenon occurred in both types of starch foam due to the increased fiber content causing clumping during the dough mixing process. A hollower foam was produced due to the uneven distribution of the fibers. Starch possesses

hydrophilic properties, making it readily bind to water (Jiang et al., 2020). Consequently, the biofoam absorbed more water upon the increase in WHF concentration.

3.4. Compressibility

Compressibility examination is a critical property for the retention of a container's shape and as an indicator of its resistance to elastic and plastic deformation. Furthermore, the type of fiber used and the storage conditions (RH) in which a starch foam is stored affect its mechanical qualities (B´en´ezet et al., 2011). The compressibility value of foam supplemented with PVA increased along with an increase in the WHF concentration and declined as the fiber content exceeded 10% (Fig. 4). A similar phenomenon was also observed in starch foam that was produced without PVA. These findings indicate that the addition of PVA increased the compressibility of the product. Additionally, it produces starch foam with a more compressible structure, which may result from the breakdown of starch hydrogen bonds and its presence in the formulation (Cinelli et al., 2006).

Iriani et al. (2015) reported that dense starch foam has high compressibility and its mechanical properties are affected by the dough-making technique. When the mixing process is not carried outuniformly and adequately, it causes clumping and inhomogeneous foam structure due to an increased fiber concentration. It occurs when a high concentration of WHF is added, which lowers the compressibility of the foam produced.

3.5. Color saturation and brightness

Fig. 5 shows that the concentration of WHF and PVA affected the foam color. The product treated with PVA had a higher saturation and a lower brightness than the untreated variant. There was also an increase in the saturation of the products due to an increase in PVA concentration. Meanwhile, an increase in the concentration of WHF caused a decrease in the brightness value.

Fig. 6 shows the foam that was produced. Comparison between foam treated with WHF and the untreated variant showed that foam with the highest WHF concentration had the darkest color (Fig. 7). It was caused by the slightly brown tint of WHF, which darkens the dough when added. This finding indicates that the higher the fiber concentration, the darker the foam obtained.

3.6. Biofoam morphology

The mechanical characteristics of starch foams are related to their morphology. Foams with denser and more consistent structures tend to exhibit

higher compressibility (Iriani et al., 2015). Furthermore, their morphology was identified with SEM images, as shown in Fig. 8. Compared with the foams without PVA (X2 and X3), its addition to the ingredients (Y2 and Y3) led to foam production with a dense and consistent structure. Samples with a higher concentration of WHF (10%) had a tighter structure and exhibited a better mechanical characteristic with or without PVA. However, excessive addition of WHF (15% or more) caused a decrease in their mechanical performance. A high fiber concentration causes clumping when the mixing process is not carried out properly (Iriani et al., 2015). Fig. 9 shows the microscopic photograph of foam indicating the existence of WHF in its structure.

3.7. Biodegradability

The biodegradability test was performed by burying the samples in soil for 42 days to determine their degradation rate. Fig. 8 shows the observation results of the samples during the analysis on days 14 (W-2), 28 (W-4), and 42 (W-6). On day 14, disintegration was detected in the foam, as indicated by the loss of shape and formation of numerous tiny fragments. It occurred with or without the addition of PVA to the samples. The weighing was not carried out due to the difficulty of collecting the disintegrated foam. Consequently, observations were only made visually on the fragments obtained from the process.

On day 42, there were two fragments from foam untreated with PVA and three fragments from the foam treated with PVA (Fig. 10). The bacteria in the soil degraded the biofoam containing starch by breaking the polymer chains into monomers through an enzymatic reaction. Cinelli ( et al. (2006) reported that the addition of natural fibers to the composites quickened material degradation. These findings confirmed that foams are biodegradable with or without the addition of PVA.

## IV. CONCLUSION

Water hyacinth is an invasive plant in the aquatic ecosystem. However, it is a potential source of fiber with good capacity and compatibility during the production of starch-based foam. The addition of its fiber in a moderate concentration (10%) could improve the physical and mechanical properties of the starch foam. However, oversupplementation (15% or more) had weakening effects, such as lowering the compressibility strength, increasing water absorption, and darkening the physical appearance of the starch foam. The

addition of 10% PVA positively affected the compressibility, density, and water absorption of the samples.

## CRDIT AUTHORSHIP CONTRIBUTION STATEMENT

Agung Nugroho: Conceptualization, Methodology, Experiment, Writing, Editing. Dessy Maulidya Maharani: Experiment, Data curation, Writing. Agung Cahyo Legowo: Experiment, Data validation, Data visualization. Sutarto Hadi: Statistical analysis. Febriani Purba: Writing, Reviewing, Editing.

## DECLARATION OF COMPETING INTEREST

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Agung Nugroho reports financial support was provided by Ministry of Education, Culture, Research, and Technology of Republic of Indonesia.

## ACKNOWLEDGMENTS

This study was funded by the Ministry of Education, Culture, Research, and Technology, Republic of Indonesia through the Basic Research Grant with the contract number of 199/E4.1/AK.04. PT/2021.

## REFERENCES

Abral, H., Kadriadi, D., Rodianus, A., Mastariyanto, P., Ilhamdi, Arief, S., Sapuan, S.M.,

Ishak, M.R., 2014. Mechanical properties of water hyacinth fibers – polyester composites before and after immersion in water. Mater. Des. 58, 125–129. https:// doi.org/10.1016/J.MATDES.2014.01.043.

Ajithram, A., Jappes, J.T.W., Brintha, N.C., 2021. Water hyacinth (Eichhornia crassipes) natural composite extraction methods and properties – a review. Mater. Today Proc. 45, 1626–1632. https://doi.org/10.1016/J.MATPR.2020.08.472.

B´en´ezet, J.C., Stanojlovic-Davidovic, A., Bergeret, A., Ferry, L., Crespy, A., 2011. Mechanical and physical properties of expanded starch, reinforced by natural fibres. Ind. Crops Prod. 37, 435–440. https://doi.org/10.1016/j.indcrop.2011.07.001.

Borrelle, S.B., Ringma, J., Lavender Law, K., Monnahan, C.C., Lebreton, L., McGivern, A., Murphy, E., Jambeck, J., Leonard, G.H., Hilleary, M.A., Eriksen, M., Possingham, H. P., De Frond, H., Gerber, L.R., Polidoro, B., Tahir, A., Bernard, M., Mallos, N., Barnes, M., Rochman, C.M., 2020. Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution. Sci. (80) 369, 1515–1518. https://doi.org/10.1126/SCIENCE.ABA3656.

Bucknall, D.G., 2020. Plastics as a materials system in a circular economy: plastics in the circular economy. Philos. Trans. R. Soc. A Math. Phys. Eng. Sci. 378. https://doi.org/10.1098/rsta.2019.0268.

Chaireh, S., Ngasatool, P., Kaewtatip, K., 2020. Novel composite foam made from starch and water hyacinth with beeswax coating for food packaging applications. Int. J. Biol. Macromol. 165, 1382–1391. https://doi.org/10.1016/J. IJBIOMAC.2020.10.007.

Cinelli, P., Chiellini, E., Lawton, J.W., Imam, S.H., 2006. Foamed articles based on potato starch, corn fibers and poly(vinyl alcohol). Polym. Degrad. Stab. 91, 1147–1155. https://doi.org/10.1016/j.polymdegradstab.2005.07.001.

Diyana, Z.N., Jumaidin, R., Selamat, M.Z., Ghazali, I., Julmohammad, N., Huda, N., Ilyas, R.A., 2021. Physical properties of thermoplastic starch derived from natural resources and its blends: a review. Polymers. Basel,. https://doi.org/10.3390/ polym13091396.

Engel, J.B., Ambrosi, A., Tessaro, I.C., 2019. Development of biodegradable starch-based foams incorporated with grape stalks for food packaging. Carbohydr. Polym. 225, 115234 https://doi.org/10.1016/j.carbpol.2019.115234.

Glenn, G.M., Orts, W.J., Nobes, G.A.R., 2001. Starch, fiber and CaCO3 effects on the physical properties of foams made by a baking process. Ind. Crops Prod. 14, 201–212. https://doi.org/10.1016/S0926-6690(01)00085-1.

Hidalgo-Crespo, J., Jervis, F.X., Moreira, C.M., Soto, M., Amaya, J.L., 2020. Introduction of the circular economy to expanded polystyrene household waste: A case study from an Ecuadorian plastic manufacturer. Procedia CIRP 90, 49–54. https://doi.org/ 10.1016/j.procir.2020.01.089.

Iriani, E.S., Irawadi, T.T., Sunarti, T.C., Richana, N., Yuliasih, I., 2015. Effect of corn vinyl alcohol on mechanical properties of cassava starch-baked foam. Polym. - Plast. Technol. Eng. 54, 282–289. https://doi.org/ 10.1080/ 03602559.2014.977423.

Jiang, T., Duan, Q., Zhu, J., Liu, H., Yu, L., 2020. Starch-based biodegradable materials: challenges and opportunities. Adv. Ind. Eng. Polym. Res 3, 8–18. https://doi.org/ 10.1016/j.aiepr.2019.11.003.

Jirawattanasomkul, T., Minakawa, H., Likitlersuang, S., Ueda, T., Dai, J.G., Wuttiwannasak, N., Kongwang, N., 2021. Use of water hyacinth waste to produce fibre-reinforced polymer composites for concrete confinement: mechanical performance and environmental assessment. J. Clean. Prod. 292, 126041 https:// doi.org/10.1016/ J.JCLEPRO.2021.126041.

Jumaidin, R., Khiruddin, M.A.A., Asyul Sutan Saidi, Z., Salit, M.S., Ilyas, R.A., 2020. Effect of cogon grass fibre on the thermal, mechanical and biodegradation properties of thermoplastic cassava starch biocomposite. Int. J. Biol. Macromol. 146, 746–755. https://doi.org/10.1016/ j.ijbiomac.2019.11.011.

Kaewpirom, S., Sungbuakaew, K., 2020. Processing, properties, and biodegradation of cassava-starch cushion foam: effects of kaolin content. Songklanakarin J. Sci. Technol. 42, 321–328. https://doi.org/ 10.14456/sjst-psu.2020.42.

Kaisangsri, N., Kowalski, R.J., Kerdchoechuen, O., Laohakunjit, N., Ganjyal, G.M., 2019. Cellulose fiber enhances the physical characteristics of extruded biodegradable cassava starch foams. Ind. Crops Prod. 142, 111810 https://doi.org/10.1016/j. indcrop.2019.111810.

Liang, Y., Tan, Q., Song, Q., Li, J., 2021. An analysis of the plastic waste trade and management in Asia. Waste Manag 119, 242–253. https://doi.org/ 10.1016/j. wasman.2020.09.049.

Machado, C.M., Benelli, P., Tessaro, I.C., 2020. Study of interactions between cassava starch and peanut skin on biodegradable foams. Int. J. Biol. Macromol. 147, 1343–1353. https://doi.org/10.1016/ j.ijbiomac.2019.10.098.

Mello, L.R.P.F., Mali, S., 2014. Use of malt bagasse to produce biodegradable baked foams made from cassava starch. Ind. Crops Prod. 55, 187–193. https://doi.org/10.1016/j.indcrop.2014.02.015.

Mohammed, A.A.B.A., Borhana Omran, A.A., Hasan, Z., Ilyas, R.A., Sapuan, S.M., 2021. Wheat biocomposite extraction, structure, properties and characterization: a review. Polymers. Basel,. https://doi.org/10.3390/polym13213624.

Salgado, P.R., Schmidt, V.C., Ortiz, S.E.M., Mauri, A.N., Laurindo, J.B., 2008. Biodegradable foams based on cassava starch, sunflower proteins and cellulose fibers obtained by a baking process. J. Food Eng. 85, 435–443. https://doi.org/10.1016/j. jfoodeng.2007.08.005.

Shogren, R.L., Lawton, J.W., Doane, W.M., Tiefenbacher, K.F., 1998. Structure and morphology of baked starch foams. Polym. (Guildf. ) 39, 6649–6655. https://doi. org/10.1016/S0032-3861(97)10303-2.

Sukhawipat, N., Yingshataporn-a-nan, T., Minanandana, T., Puksuwan, K., Saengdee, L., Nakaramontri, Y., Sosa, N., Saetung, N., 2021. Effects of water hyacinth fiber size on sound absorption properties of advanced recycled palm oil-based polyurethane foam composite. Mater. Today Proc. https://doi.org/10.1016/J.MATPR.2021.10.417.

Sumardiono, S., Pudjihastuti, I., Amalia, R., Yudanto, Y.A., 2021. Characteristics of biodegradable foam (bio-foam) made from cassava flour and corn fiber. IOP Conf. Ser. Mater. Sci. Eng. 1053, 012082 https://doi.org/10.1088/1757-899x/1053/1/ 012082.

Syafri, E., Jamaluddin, Wahono, S., Irwan, A., Asrofi, M., Sari, N.H., Fudholi, A., 2019. Characterization and properties of cellulose microfibers from water hyacinth filled sago starch biocomposites. Int. J. Biol. Macromol. 137, 119–125. https://doi.org/ 10.1016/J.IJBIOMAC.2019.06.174.

Vargas-Torres, A., Palma-Rodriguez, H.M., Berrios, J.D.J., Glenn, G., SalgadoDelgado, R., Olarte-Paredes, A., Prieto-Mendez, J., Hernandez-Uribe, J.P., 2017.

Biodegradable baked foam made with chayotextle starch mixed with plantain flour and wood fiber. J. Appl. Polym. Sci. 134, 1–8. https://doi.org/10.1002/app.45565.

Vercelheze, A.E.S., Fakhouri, F.M., Dall'Antonia, ˆ L.H., Urbano, A., Youssef, E.Y.,Yamashita, F., Mali, S., 2012. Properties of baked foams based on cassava starch, sugarcane bagasse fibers and montmorillonite. Carbohydr. Polym. 87, 1302–1310. https://doi.org/10.1016/j.carbpol.2011.09.016.

# 23. Physicochemical Properties of Mesoporous Organo-Silica Xerogels Fabricated through Organo Catalyst

Muthia Elma[1], Anna Sumardi[2], Adhe Paramita[3], Aulia Rahma[4], Aptar Eka Lestari[5] Dede Heri Yuli Yanto[6], Sutarto Hadi [7], Zaini Lambri Assyaifi[8], Sunardi[9] and Yanuardi Raharjo[10]

[1,2,3,4,5,7,8,9]Lambung Mangkurat University, Indonesia. [6]Research Center for Biomaterials, Indonesian Institute of Sciences. [10]Universitas Airlangga, Surabaya.

**ABSTRACT**

The physicochemical properties of organo-silica xerogels derived from organo catalyst were pervasively investigated, including the effect of one-step catalyst (citric acid) and two-step catalyst (acid-base), and also to observe the effect of sol pH of organo-silica xerogel toward the structure and deconvolution characteristic. The organo-silica xerogels were characterized by FTIR, TGA and nitrogen sorption to obtain the physicochemical properties. The silica sol–gel method was applied to processed materials by employing TEOS (tetraethyl orthosilicate) as the main precursor. The final molar ratio of organo-silica was 1:38:x:y:5 (TEOS:ethanol: citric acid: NH3 :H2O) where x is citric acid concentration (0.1–10 × 10-2 M) and y is ammonia concentration (0 to 3 × 10-3 M). FTIR spectra shows that the one-step catalyst xerogel using citric acid was handing over the higher Si-O-Si concentration as well as Si-C bonding than the dual catalyst xerogels with the presence of a base catalyst. The results exhibited that the highest relative area ratio of silanol/siloxane were 0.2972 and 0.1262 for organo catalyst loading at pH 6 and 6.5 of organo-silica sols, respectively. On the other hand, the organo-silica matrices in this work showed high surface area 546 m2 g -1 pH 6.5 (0.07 × 10-2 N citric acid) with pore size

~2.9 nm. It is concluded that the xerogels have mesoporous structures, which are effective for further application to separate NaCl in water desalination.

Keywords: organo-silica xerogel; mesoporous material; one-step catalyst; two-step catalyst

## I. INTRODUCTION

Materials of mesoporous structure are synthesized by sol–gel process, which is a versatile approach to form functional materials for membranes, sensors, catalytic and optical applications. In the past few years, fabrication and application of thin film as a membrane for separation have become a concern to development, especially for desalination. There are two types of materials commonly used such as organic and inorganic. Organicbased materials such as polymers are widely utilized for water purification, and inorganic for gas separation. However, inorganic-based materials are offering more advantages, i.e., robustness, high molecular sieving, resistance to high temperature and long lifespan. Silica is one inorganic based material that has good chemical stability and is affordable to be employed for preparation xerogel. This is due to their corresponding porosity, surface area [1–4] and morphological control [5–7].

Various formulation of sol–gel processes has been utilized by researcher to fabricate a high-quality membrane. Raman et al. [8] demonstrated the purpose of an organic templated rapprochement for membrane synthesis with good pore design ability. The study reported the use of TEOS and MTES as silane precursors with HCl as a catalyst in the sol–gel preparation for intermediate layers for gas permeation.

Pure silica membrane-derived TEOS synthesis by two-step (nitric acid-ammonia) catalyst has been studied by Elma et al. [9]. Although this material produces a mesoporous structure that is good for desalination, the membrane performance still decreases. The decrease of salt rejection for the pure silica membranes and changes in the flux regime strongly suggests that pure silica films are not hydro-stable. These membranes have a large concentration of silanol (Si-OH) groups, which are hydrophilic in behavior. As water exposes with silanols, it causes the silica to become mobile.

To address the hydro-stability of porous silica matrices, several functional groups have embedded structural stabilizing unities into the silica matrix.

These have included carbonization of cationic surfactants, hybrid with carbon/ surfactant [10–12], covalently bonded templates, and doping of metal oxides based on cobalt [13–15].

Wijaya et al. [16] reported the manufacture of carbonized template silica (CTS) membrane by two-step acid catalyst using nitric acid, TEOS and surfactants C16 (hexadecyltrimethylammonium bromide). These works obtain high surface BET of 793 m2 g -1 and pore volume 0.37 cm3 g-1. The CTS membranes are hydro-stable, though flux tends to vary as a function of time. However, the surfactant of C16 is very costly and is not a renewable material. It is also similar to another study published by Yang et al. [17]employing P123.

There are several studies to overcome the costly and environmentally friendly issues as an option material for manufacturing carbon-silica-based membrane. Pectin is one of carbon source that can be used for fabrication of carbon-silica membrane [18]. Preparation of silica-pectin membrane was performed by two-step (nitric acid-ammonia) catalyst and a template of pectin from apple peel. The performance of membrane shows excellent high water flux over 7 kg m-2 h-1 for brackish water desalination. However, template strategies meant that the membrane fabrication spent more time above 6 h. Due to that, it may be necessary to apply hybrid strategies to shorten the production membrane time under 6 h.

Chua et al. [19] reported that hybrid membrane was prepared under a two-step catalyst using HCl as an acid catalyst, BTESE as a precursor and carbon as a surfactant. Its membrane has a high surface area BET, pore volume and pore size of 310 m2 g-1, 0.18 cm3 g -1 and 2 nm, respectively. However, this membrane still has limitations due to salt deposits on the permeate side of membrane surface at high saline feed water, which has a higher risk of pore wetting. Therefore, the membrane properties and surface chemistry need to be well designed and balanced to ensure a high permeation flux, perfect salt rejection and no pore wetting within the system.

The study published by Sumardi et al. [20] investigated a mesoporous hybrid organosilica thin film from organic catalyst. Instead of using TEOS as a silane precursor, this research combined dual precursor with TEVS to enrich the carbon into silica matrices. Moreover, the utilization of organo catalyst (e.g., citric acid) also has a role as a carbon source and to control the pore size structure, whereas the use of single precursor by TEOS and organo catalyst for the fabrication of organo-silica membrane is not the focus of the investigation.

The above review shows that conventionally high-quality silica-based membranes have been synthesised by sol–gel processes mainly including a single-step catalysed hydrolysis of TEOS using HNO3 as a catalyst, or a templated single-step, or templated two-step using HCl followed by pore tuning processes. The employment of a two-step catalysed hydrolysis process has also been reported to prepare high-quality silica-based membranes.

The two-step hydrolysis condensation of silicon polymers results in the formation of weakly branched systems [21]. For weakly branched systems, there is a higher tendency for structures to interpenetrate, forming large structures of micropore size, resulting in densification and apertures of molecular sieve dimensions.

The purpose of this study was to employ citric acid to produce a silica thin film using one- and two-step organic acid-base catalysts for the sol–gel process, which is very popular in the membrane technology field. Other than that, tailoring of pore size of thin film depended on silica sol pH values. The decrease of the pH determines the shrinking of the pore size in the silica matrices to micropores [7]. Therefore, it requires to ensure the sol pH is varied by the addition of different citric acid concentrations.

This work will show that one of important features of the one- and two-step sol–gel processed organo-silica membranes is greater pore size tailor ability allowing superior desalination performance over conventional one- and two-step with template or hybrid dual precursor processed membranes. Hence, the fundamental measures will be used to test the novel features of this study. First, we will investigate the structural characteristics of the organo-silica xerogels based on FTIR, N2 physisorption correlated to surface structure and pore size, and TG analysis, which can be correlated to the surface-functionalization mechanism in organo-silica xerogels.

## II. MATERIALS AND METHODS

### 2.1. Chemical and Materials

Several materials and chemicals have been employed for this work, i.e., tetraethyl orthosilicate (TEOS, 99.0%, (GC) Sigma-Aldrich, St. Louis, MO, USA) as silica precursor, ammonia solution (NH3, 25%, Merck, Darmstadt, Germany), diluted citric acid (0.001 M C6H8O7), ethanol (EtOH, 99%) as a solvent and demineralized water. The organosilica sol–gel set-up was described in Figure 1.

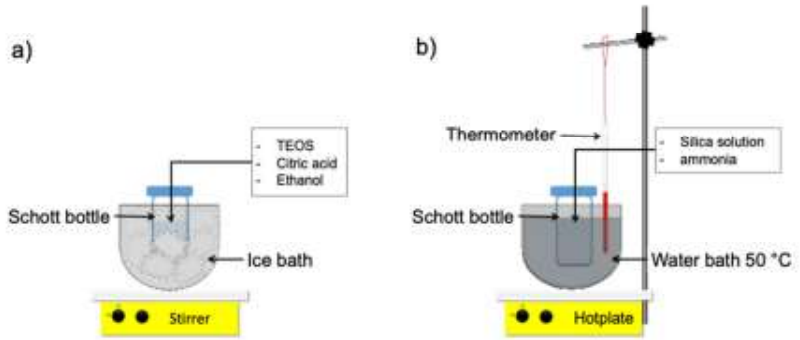



**Figure 1.** Schematic of organo-silica sol–gel process set-up (**a**) mixing process at 0 °C (**b**) mixing process at 50 °C.

## 2.2. Synthesis of Sol Gel Process

The silica sol was synthesized by a simple sol–gel technique, of which the following detail procedure refers to our previous work [22,23]. Firstly, silica sol via two-step catalyst was prepared by mixing TEOS and ethanol for 5 min in an ice bath at 0 °C with 250 rpm; subsequently, the diluted citric acid with demineralized water was dropwise, and the reagent bottle was moved from an ice bath into a water bath and subsequently reflux for an hour at 50 °C with mixing speed 2500 rpm. Afterward, the diluted ammonia with ethanol was added dropwise within 20 min into the solution for 2 h by mixing it in similar conditions. The final pH of organo-silica sol formed was left cold and measured using a pH meter. Meanwhile, the one-step catalyst was prepared in a similar way, but without ammonia, the reflux time became 3 h.

The reagent bottle was prepared and submerged into a bowl as shown in Figure 1a in an ice bath at 0 $^0$C; the second condition is under heating at 50 $^0$C using a water bath, as shown in Figure 1b. The various organo-silica sol pH measurements were prepared similar to the two-step catalyst procedure with various citric acid concentrations. The final molar ratio of multiple organo-silica xerogels was listed in Table 1. 2.3.

**Table 1.** List of final molar ratio of organo-silica sol.

| Sols | TEOS | EtOH [$\times 10^1$] | $C_6H_8O_7$ [$\times 10^{-2}$] | $NH_3$ [$10^{-3}$] | $H_2O$ |
|---|---|---|---|---|---|
| One-step catalyst [pH 4.4] | 1 | 3.8 | 0.1 | - | 5 |
| Two-step catalyst [pH 4.4] | 1 | 3.8 | 0.1 | 3 | 5 |
| pH 4 | 1 | 3.8 | 10 | 3 | 5 |
| pH 6 | 1 | 3.8 | 0.1 | 3 | 5 |
| pH 6.5 | 1 | 3.8 | 0.07 | 3 | 5 |

Preparation and Characterization of Organo-Silica Xeorgel

The obtained organo-silica sol was following placed in the Petri dish and dried in oven at 60 $^0$C for 24 h. Hereinafter, the dried sol was named organo-silica xerogel. The organosilica xerogel was grounded to a powder and calcined at 200 $^0$C using a furnace under air condition by the RTP (rapid thermal processing) technique for 1 h without applying ramping/cooling rates.

FTIR (Fourier transform infra-fed) is used to investigate the chemical properties of silica-carbon xerogels. FTIR spectra data were collected from FTIR type Bruker Alpha. Instrument type: alpha sample compartment RT-DLaTGS accessory: ATR platinum Diamond 1 Relf. The spectra were col lected from a total of 30 scans ranging between wavelengths of 600–4000 cm-1. Peak deconvolution of the absorption bands over the region 1300–700 cm-1 was performed with Fityk software using Gaussian line shapes with a least square fit routine [24] and peak areas were measured for the normalized spectra using a local baseline. Nitrogen physisorption analysis at 77 K and 1 bar were conducted using a Micromeritics TriStar 3000 instrument. The sample was degassed under vacuum for 6 h at 200 $^0$C. The specific surface area was determined from the Brunauer, Emmett and Teller (BET) method. The Dubinin–Astakhov and Barrett–Joyner–Halenda methods were taken to determine the average pore sizes of microporous and mesoporous materials, respectively. Thermogravimetric analysis (TGA) was performed using a differential scanning calorimeter/thermogravimetric analyzer (Mettler-Toledo, TGA/DSC 1, Columbus, OH, USA) from 30 $^0$C to 800 $^0$C using 5 $^0$C min in air atmosphere.

## 3. Results and Discussions

### 3.1. Effect of One-Step and Two-Step Catalyst on Preparation of Organo-Silica Xerogel

The FTIR spectra of one-step catalyzed (citric acid) and two-step catalyzed (acid-base) xerogels calcined at 175 ?C in air is presented in Figure 2. All the xerogels, independently of their addition of step catalyst, showed similar vibrational bands in the region of 1400–600 cm-1. The peak of interest appearing at 940 cm-1 is attributed to the vibrational stretching of the silanol (Si-OH) groups. The other intense peak near 1070 cm-1 along with bands of 1170 and 1060 cm-1 were all assigned to various stretching and bending vibration of the siloxane (Si-O-Si) groups. Meanwhile, the peak at 800 cm-1 was appropriated to the silica-carbon (Si-C) vibration band. A scan of the spectral profiles looks identical to previous study reported by Rahman et al. [25], which indicated at wavelength 958 cm-1 and 1280–760 cm-1 of silanol and siloxane, respectively. This is because the chemical constituents are tremendously

similar in all the silica-carbon-based xerogels. The alteration of the vibrational bands connected to the silanol and siloxane concentration was quantitativelyassessed by a deconvolution of the IR spectra bands at 940, 1060 and 800 cm-1.

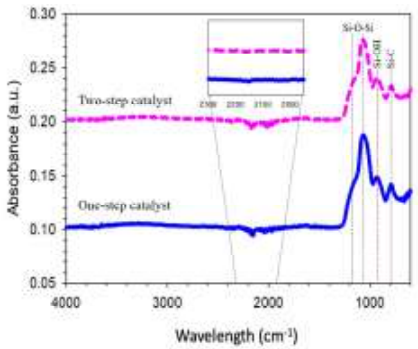



**Figure 2.** FTIR spectra of one-step catalyst (citric acid) and two-step catalyst (acid-base) xerogels calcined at 175 °C.

The peak area ratio analysis regarding the silanol against the siloxane groups of one-step catalyst (citric acid) and two-step catalyst (acid-base) xerogels is displayed in Figure 3. The results exhibit that this ratio increases as the pH is increased from using one-step catalyst down to two-step catalyst. This behavior could be explained on the basis that the pH-dependency of the hydrolysis, condensation and polymerization reactions for porous properties of TEOS-derived silica have been reported extensively in several works [26–28]. These results clearly indicate that the lowest silanol concentrations, and likewise, the highest siloxane bridge concentrations, were achieved with calcined xerogels prepared with pH 6 (two-step catalyst) and pH 4.4 (one-step catalyst) (Figure 3).

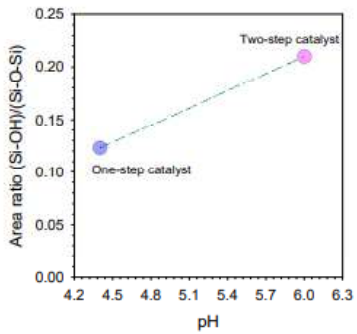



**Figure 3.** Deconvoluted peak area ratios of silanol/siloxane (940 $cm^{-1}$)/(1070 $cm^{-1}$) as a function of pH to perform various one-step catalyst (citric acid) and two-step catalyst (acid-base) xerogels.

In the sol–gel process by two-step catalysed (acid-base) xenogels, the first step was executed at pH ~4 (under an acidic condition) under reflux. Acid catalysed hydrolysis with heating promoted a high production of silanol species from the silane precursor of TEOS [29]. In the second step, the sol pH is adjusted by the addition of the ammonia hydroxide; the pH increases rapidly to >4, which is much higher than the isoelectric point boundary (pH 1–3) of the silica species. Instantly, the silanol species are expected to all be deprotonated while participating in the polycondensation reaction, generating a large concentration of highly siloxane species [9]. However, the result is contrary to Elma, Riskawati and Marhamah's [9] work, which produced the highest silanol on two-step catalyst, as shown in Table 2. This suggests the difference of acid catalyst usage, e.g., organo catalyst (citric acid) instead of nitric acid in this work.

**Table 2.** Deconvolution of Si-OH/Si-O-Si concentration.

| Xerogels | Sol pH | Area ($Q^n$) | | | Area Ratio Si-OH/Si-O-Si |
|---|---|---|---|---|---|
| | | Si-O-Si | Si-OH | Si-C | |
| Two-step catalyst | 6 | 4.999 | 1.039 | 0.339 | 0.207 |
| One-step catalyst | 4.4 | 4.478 | 0.540 | 1.036 | 0.120 |

The citric acid acts as a catalyst and carbon source for tailoring organo-silica membrane, of which the structure and surface properties become stronger and have a good hydro-stability [2]. Despite this, the silanol species is generated the most in two-step catalyst compared to one-step catalyst, but the siloxane also forms the most in two-step catalyst (Table 2). The siloxane formation is promoted by condensation reactions during the addition of base catalyst. Moreover, the organo catalyst (e.g., citric acid) also favoured the siloxane formation, in line with results reported by Sumardi, Elma, Rampun, Lestari, Assyaifi, Darmawan, Yanto, Syauqiah, Mawaddah and Wati [20] in the designing of mesoporous hybrid organo-silica using organo-catalyst with different silica precursors (TEVS). It may be assumed that the Si-OH bonds were reduced and converted to be other bonds such as Si-C, C=C, etc. This is due to the carbon content of citric acid as a catalyst [2]. In addition, the production of high siloxane groups in silica-based membrane has been reported to enhance the hydro-stability [16,17,30,31]. Therefore, based on the results, the presence of organo catalyst could produce more siloxane bridges and could decrease the hydro-instability.

Isotherms for the bulk organo-silica xerogels are shown in Figure 4 for

both one- and two-step catalyst bulk xerogel samples. The isotherms for multiple xerogels are of type I, classified as microporous materials. Table 3 sorts the calculated values for the surface area (SBET), total pore volume, and average pore size. It is observed that one-step catalyst with the addition of citric acid may lead to an increase in both the SBET and total pore volume of 264 m2 g -1 and 0.0125 cm3 g-1, while the average pore size was slightly more reduced than the two-step catalyst. These results indicated that organo catalyst provided important qualitative information about the microstructure of the resulting molecular sieving membrane. The carbon content in xerogels during the calcination step remained in the matrices of silica and is expected to produce microporous materials, which potentially be the result of shrinkage of the silica framework during calcination of organo infiltrated into the silica pores [12,32].

The isotherm profiles of all the xerogels prepared at different step catalysis perform a quite similar nature. Xerogels synthesized in both one- and two-step catalyst show a tendency to form micro- and mesoporous material as the adsorption saturation is achieved above 0.65 P/P0 with capillary condensation leading to hysteresis approaching 0.04 P/P0. These results, verified with a higher number of siloxane species, are shown in Figure 2. On the other hand, type I isotherms with hysteresis indicated a typical micro/mesoporous material.

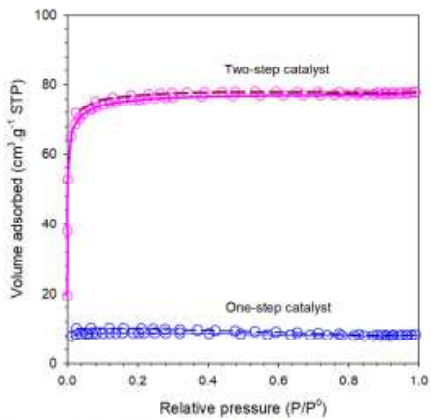



**Figure 4.** Plots of $N_2$ isotherm data of the one-step catalyst and two-step catalyst xerogels calcined at 175 °C.

**Table 3.** Surface properties of the organo-silica xerogels.

| Xerogel | pH | $S_{BET}$ ($m^2$ $g^{-1}$) | Pore Volume ($cm^3$ $g^{-1}$) | Average Pore Diameter (nm) |
|---|---|---|---|---|
| Two-step catalyst | 6 | 234.273 | 0.012015 | 2.9208 |
| One-step catalyst | 4.4 | 264.276 | 0.01251 | 2.5939 |

Although from plot N2, sorption isotherms in Figure 4 explained that the pore size is microporous material. All the organo-silica xerogels were categorized as slightly mesoporous structures, which have an average pore size range between 2 and 50 nm. It is shown that the pore size of both samples are 2.9 and 2.6 nm of two- and one-step catalyst samples, respectively (Table 3). Hence, meso-porosity correlates well with controlled concentrations of silanol/siloxane groups and appropriates with the deconvolution of the area ratio [Si-OH]/[Si-O-Si], as shown in Figure 3. These results are also in line with previous reports on silica-based membranes [26,28,33].

The xerogel used in this study was carbonized at 175 ?C; the TGA combustion was carried out up to 800 ?C to investigate the weight loss for all components of silica-carbon matrices. As seen in Figure 5, three regions can be explained about the weight loss of component masses. The first area is the loss of volatile components such as moisture, solvents, and monomers. The mass loss was decreased rapidly by ±10% at temperature 30–120 $^{0}$C; this could be due to physiosorbed water removal in both one- and two-step catalyst samples. It normally happened because the silica material has a hydrophilic nature and easily absorbs water molecules through hydrogen bond (OH) groups of silanol species [34,35]. Hence, it could be remaining in the carbon-silica matrix, as observed in the IR spectrum in Figure 2. Based on the results, organo-silica xerogels prepared in one- andtwo-step using organo catalyst appear to be very similar to carbon-silica-based xerogel, which carbonized with surfactant, as reported by Duke et al. [36].

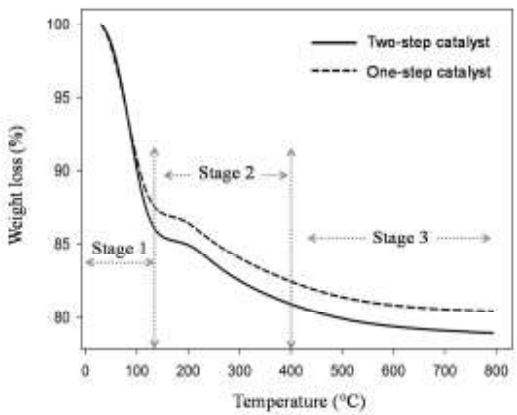



**Figure 5.** Weight loss curves of silica xerogel for dual catalyst (with ammonia) and single catalyst (without ammonia) as a function of temperature.

Figure 5 exhibits the xerogel prepared in two-step catalyst may absorb more water(15%) than the xerogel in one-step catalyst or organo catalyst (12%). The TG profile present at stage 2 experienced a decomposition process. The material starts to burn and decompose during this stage at 70 to 200 °C. All component materials are not completely decomposed in the second stage. Hereafter, the third stage occurred at temperatures up to 200 °C; the xerogel in two-step catalyst performed a large mass loss compared to one-step catalysts. It is clearly seen that without base addition, the sample is easier to decompose. The third stage phenomenon could have also been caused by carbon decomposition and combustion reactions. Figure 5 shows that the trends for all samples are similar to create flat lines. This means that the high temperature of calcination lead itself to the material completely decomposing. In addition, carbon from the citric acid chain easily burns at temperatures above 175 °C.

### 3.2. Effect of Sol pH in Organo-Silica Xerogels toward Structure and Fuctionalization Properties

The representative FTIR spectra for the organo-silica xerogels in different citric acid concentrations are presented in Figure 6a. The multiple citric acid concentration in silica sol were indicated by the sol pH of pH 4 (10 × 10-2 M C6H8O7), pH 6 (0.1 × 10-2 M C6H8O7) and pH 6.5 (0.07 × 10-2 M C6H8O7). The FTIR spectra shows the vibration band of silica and carbon compound at a wavelength region range of 1400–700 cm-1. Figure 6a displays that siloxane bridges (Si-O-Si) had stretching modes at bands near 1180, 1088 and 795 cm-1 for all varied pH, whilst, assigned at shoulder band, is silanol groups (Si-OH) at 940 cm-1. This result was similar to previous work reported by Rahman, Maimunawaro, Rahma, Isna and Elma [25] and Ayu Lestari et al. [37]; neither the functionalizing group of silanol or siloxane appeared in the samples. This is due to the xerogels that were fabricated containing silica and carbon from a templating agent (triblock copolymer P123). The silanol and siloxane vibration bands come forth because of the sol–gel process through hydrolysis and condensation reaction [13,38,39]. Silanol groups were formed during hydrolysis reaction and bridges formed under the condensation reaction. Other than that, tion and bridges formed under the condensation reaction. Other than that, deconvolution and condensation reaction [13,38,39]. Silanol groups deconvolution FTIR data results by Fityk sofware in show in Figure 6b.

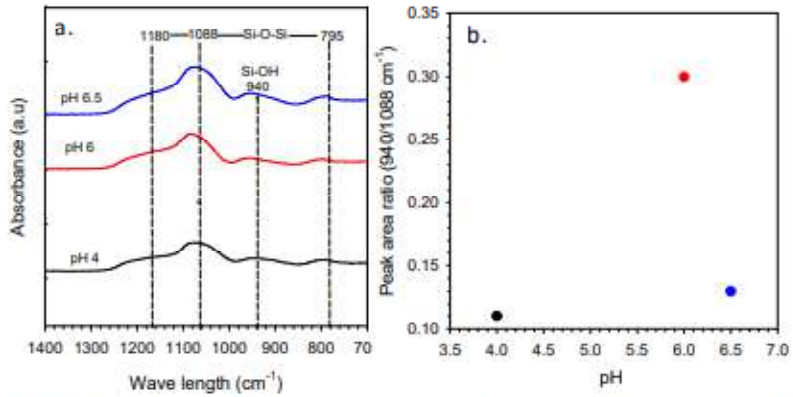



**Figure 6.** (**a**) FTIR spectra of organo-silica xerogels at varied pH and (**b**) the peak area ratio of silanol/siloxane for the function of sol pH.

The spectra FTIR data have been processed to peak fitting using Gaussian functional with error limit ±0.5% and using unit Qn according to Park [40] publication. Based on Figure 6b, the result shows the highest relative peak area ratio of silanol/siloxane conducted at sol pH 6 of 0.3 Qn (0.1 × 10-2 M $C_6H_8O_7$). This result is higher than Elma et al.'s peak ratio, which only found 0.004–0.016 Qn [41]. It might be that this work is preferred using an organic catalyst (citric acid) and other reports using inorganic catalyst (nitric acid) to prepare silica xerogel. Figure 6b shows that the peak area ratio increases by increasing the pH to pH 6, and dropped significantly at pH 6.5. This is due to the dependence of hydrolysis, condensation and polymerization reactions for the TEOS system described as the principle of the sol–gel process [42]. At pH 6.5, the ostwald maturation occurs, wherein in this condition there is a very rapid growth of particles under conditions and the weak polymer crosslinking formed at the first hydrolysis stage tends to weaken, even releasing and then settling. This is because the ratio of silanol/siloxane decreases at pH values above 6. N2 isotherm curves of various pH are shown in Figure 7. As shown in Figure 7, both pH 6 and pH 6.5 have structure type IV isotherm with H4 hysteresis loops. Generally, the hysteresis loop H4 was a classification for the sample composed of ordered structures such as silica; meanwhile, type IV indicated mesoporous materials [42]. Xerogel at pH 6 was hysteresis from ~0.1 P/P0 to ~0.7 P/P0. These results exhibit a different structure because they simply used two-step catalyst (citric acid-ammonia), which was distinctive to Elma, Fitriani, Rakhman and Hidayati's [15] work with two-step catalyst (nitric acid-ammonia). Moreover, calcination techniques have also contrib-

uted to the xerogel structure produced. The RTP (rapid thermal process) technique makes the xerogels become dense over the CTP (conventional thermal process) technique, which is the way the structure becomes micro/mesoporous. All samples show a similar trend by relative pressure measurement, even though differently from the pore volume, as shown in Table 4

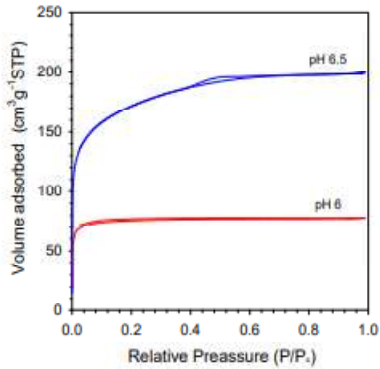



**Figure 7.** $N_2$ physisorption isotherms of organo-silica xerogels at varied pH.

**Table 4.** Surface properties of organo-silica xerogels at varied types.

| Xerogels Types | Materials/Catalyst | Calcined Temp. (°C) | $S_{BET}$ ($m^2$ $g^{-1}$) | Pore Volume ($cm^3$ $g^{-1}$) | Average Pore Diameter (nm) | Ref. |
|---|---|---|---|---|---|---|
| Organo-silica pH 6 (calcined in air) | TEOS/citric acid-ammonia | 175 | 234 | 0.12 | 2.05 | This work |
| Organo-silica pH 6.5 (calcined in air) | TEOS/citric acid-ammonia | 175 | 546 | 0.31 | 2.21 | This work |
| Carbon-silica (calcined in vacuum) | TEVS-P123/nitric acid-ammonia | 450 | 761 | 0.62 | 2 | [12] |
| Carbon-silica (calcined in $N_2$) | TEVS-P123/nitric acid-ammonia | 450 | 526 | 0.34 | 2.56 | [17] |
| Cobalt oxide silica (calcined in vacuum) | TEOS-cobalt/ammonia | 600 | 450 | 0.23 | <2 | [42] |
| Cobalt oxide silica (calcined in vacuum) | ES40-cobalt/ammonia | 600 | 440 | 0.18 | >2 | [42] |

Table 4 displays the summary of surface properties of organo silica xerogels at varied citric acid concentrations, which represent the pH value of organo-silica sol. The SBET of sol pH 6 calcined at 175 ?C in air condition appears smaller than other types of xerogels in Table 4 of 234 m2 g-1. Excellently, pH 6.5 shows a higher surface area than other samples of 546 m2 g-1. Meanwhile, SBET organo-silica sol pH 6.5 was higher than pH 6, at about57%. This is because the high amount of organo catalyst concentration was added into the sol. The SBET of organo-silica pH 6.5 in this work is higher by 4% and 18% than the carbon-silica and cobalt-oxide-silica xerogels [17,42], respectively. On the other hand, the total pore volume of organo-silica was also slightly higher by 26% over cobalt oxide silica xerogel like shown in Table 4. Moreover, all xerogels resulted in average pore sizes 2.05 and 2.21 nm of pH 6 and

pH 6.5, respectively. It is concluded that the sols are potentially applied as a membrane for desalination application. The TG analysis result was carried out to understand the mass loss behavior of a sample with varied citric acid concentrations (sol pH), as shown in Figure 8. It is interesting to observe that the mass loss profiles of organo-silica xerogels of different pH show a similar trend. The initial mass losses up to 100 ?C were very similar and were mainly attributed to the desorption of water in the porous structure of both pH 6 and pH 6.5 organo-silica xerogel samples. After 250 ?C, mass losses became significant as 17 wt% took place prior reaching ~280 ?C, though these samples remained black, much akin to the color of carbon in the pH 6.5 sample. In both sample pH 6 and pH 6.5, the minor mass losses occurring in stage 2 at ~200 ?C were mainly associated with further condensation reactions of the silanol group. These results suggest that the minor mass loss occurred due to the breaking down and/or loss of organic carbons groups in the organo catalyst. The mass loss curves in this work were different with the carbon-silica xerogel calcined at vacuum and N2 reported by Yang et al. [17]. A steady loss of the volatile organic occurred between 100 and 500 ?C, which was caused by degradation of carbon from citric acid into smaller fragments continuously over this temperature.

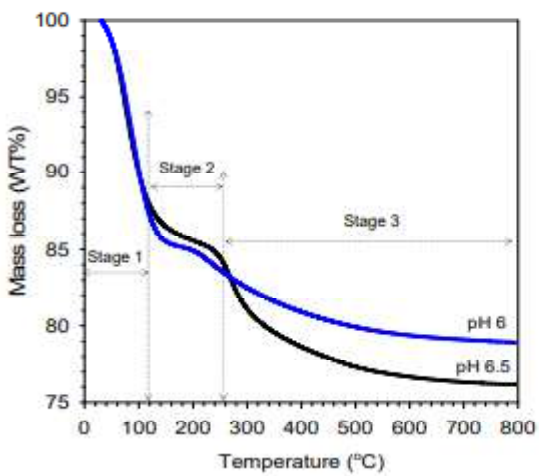



**Figure 8.** TGA mass loss curves of organo-silica xerogel in varied pH as function of temperature exposed.

## IV. CONCLUSIONS

The mesoporous organo-silica xerogel has been successfully produced using organoacid via one-step and two-step (acid-base) catalyst by the sol–gel method. The results exhibit both the one-step and two-step catalyst obtaining good structure properties included high surface BET, pore volume and micro/mesoporous structure material. Nevertheless, two-step catalyst demonstrates that the functionalization has higher siloxane groups compared to the one-step catalyst, which is associated with good hydro-stability properties in those materials. It is also followed by the larger pore size in two-step catalyst that could be suitable for desalination application. In addition, the effect of pH on organo-silica xerogels toward psychochemical properties were observed. The pH 6.5 organo-silica xerogel by two-step catalyst showed excellent structure and functionalization properties that had high SBET, pore volume, mesoporous structure (2.2 nm) and a lower peak area ratio of silanol/siloxane groups. In the other hand, all organo-silica xerogels calcined at 175 °C were able to maintain the carbon bonds contained from organo acid in silica matrices. It is evidenced with TG analysis that up to 175 °C, the carbon decomposed.

**Author Contributions:** Conceptualization, M.E., A.S. and A.P.; methodology, A.S., A.P., A.K.L.; software, A.S., A.P., A.K.L. and A.R.; validation, M.E. and A.R.; formal analysis, D.H.Y.Y.; investigation, Z.L.A.; resources, S.; data curation, A.S. and A.P. and A.K.L.; writing—original draft preparation, A.S. and A.P. and A.E.L. and Z.L.A.; writing—review and editing, M.E. and A.R.; visualization, Y.R.; supervision, M.E.; project administration, S.H.; funding acquisition, M.E. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by "Directorate General of Higher Education, Ministry of Education, Culture, Research, and Technology" and "The APC was funded by Applied Research of Universities Grant 2021–2023, Basic Research Grant 2021–2022 and World Class Research Grant 2021–2023 Deputy of Research and Development National Research and Innovation Agency".

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Acknowledgments:** The authors give thanks to Materials and Membranes Research Group (M2ReG) Lambung Mangkurat University for support and facilities and sample characterization at Research Center for Biomaterials, Indonesian Institute of Sciences.

**Conflicts of Interest:** The authors declare no conflict of interest.

## REFERENCES

1. Danks, A.; Hall, S.R.; Schnepp, Z. The evolution of 'sol–gel' chemistry as a technique for materials synthesis. Mater. Horizons 2016, 3, 91–112. [CrossRef]
2. Elma, M.; Setyawan, H. Synthesis of Silica Xerogels Obtained in Organic Catalyst via Sol Gel Route. IOP Conf. Ser. Earth Environ. Sci. 2018, 175, 012008. [CrossRef]
3. Waqas, S.; Bilad, M.R.; Man, Z.B.; Suleman, H.; Nordin, N.A.H.; Jaafar, J.; Othman, M.H.D.; Elma, M. An energy-efficient membrane rotating biological contactor for wastewater treatment. J. Clean. Prod. 2021, 282, 124544. [CrossRef]
4. Razak, N.N.A.N.; Rahmawati, R.; Bilad, M.R.; Pratiwi, A.E.; Elma, M.; Nawi, N.I.M.; Jaafar, J.; Lam, M.K. Finned spacer for enhancing the impact of air bubbles for membrane fouling control in Chlorella vulgaris filtration. Bioresour. Technol. Rep. 2020, 11, 100429. [CrossRef]
5. Trewyn, B.G.; Slowing, I.I.; Giri, S.; Chen, H.-T.; Lin, V.S.Y. Synthesis and Functionalization of a Mesoporous Silica Nanoparticle Based on the Sol–Gel Process and Applications in Controlled Release. Acc. Chem. Res. 2007, 40, 846–853. [CrossRef]
6. Uhlmann, D.; Liu, S.; Ladewig, B.P.; da Costa, J.C.D. Cobalt-doped silica membranes for gas separation. J. Membr. Sci. 2009, 326, 316–321. [CrossRef]
7. Elma, M.; Hairullah; Assyaifi, Z.L. Desalination Process via Pervaporation of Wetland Saline Water. IOP Conf. Ser. Earth Environ. Sci. 2018, 175, 012009. [CrossRef]
8. Raman, N.K.; Anderson, M.T.; Brinker, C.J. Template-Based Approaches to the Preparation of Amorphous, Nanoporous Silicas. Chem. Mater. 1996, 8, 1682–1701. [CrossRef]

9. Elma, M.; Riskawati, N.; Marhamah. Silica Membranes for Wetland Saline Water Desalination: Performance and Long Term Stability. IOP Conf. Ser. Earth Environ. Sci. 2018, 175, 012006. [CrossRef]
10. Isaeva, V.I.; Chernyshev, V.V.; Fomkin, A.A.; Shkolin, A.V.; Veselovsky, V.V.; Kapustin, G.I.; Sokolova, N.A.; Kustov, L.M. Preparation of novel hybrid catalyst with an hierarchical micro-/mesoporous structure by direct growth of the HKUST-1 nanoparticles inside mesoporous silica matrix (MMS). Microporous Mesoporous Mater. 2020, 300, 110136. [CrossRef]
11. Elma, M.; Mujiyanti, D.R.; Ismail, N.M.; Bilad, M.R.; Rahma, A.; Rahman, S.K.; Rakhman, A.; Rampun, E.L.A. Development of Hybrid and Templated Silica-P123 Membranes for Brackish Water Desalination. Polymers 2020, 12, 2644. [CrossRef]
12. Yang, H.; Elma, M.; Wang, D.K.; Motuzas, J.; da Costa, J.C.D. Interlayer-free hybrid carbon-silica membranes for processing brackish to brine salt solutions by pervaporation. J. Membr. Sci. 2017, 523, 197–204. [CrossRef]
13. Elma, M.; Saputro, G.S. Performance of Cobalt-Silica Membranes through Pervaporation Process with Different Feed Solution Concentrations. Mater. Sci. Forum 2020, 981, 342–348. [CrossRef]
14. Rampun, E.L.A.; Elma, M.; Rahma, A.; Pratiwi, A.E. Interlayer-free silica–pectin membrane for sea-water desalination. Membr. Technol. 2019, 2019, 5–9. [CrossRef]
15. Elma, M.; Fitriani; Rakhman, A.; Hidayati, R. Silica P123 Membranes for Desalination of Wetland Saline Water in South Kalimantan. In Proceedings of the IOP Conference Series: Earth and Environmental Science, Makassar, Indonesia, 25–26 October 2017; 2017; p. 012007.
16. Wijaya, S.; Duke, M.C.; Diniz da Costa, J.C. Carbonised template silica membranes for desalination. Desalination 2009, 236, 291–298. [CrossRef]
17. Yang, H.; Wang, D.K.; Motuzas, J.; da Costa, J.C.D. Hybrid vinyl silane and P123 template sol-gel derived carbon silica membrane for desalination. J. Sol-Gel. Sci. Technol. 2017. [CrossRef]
18. Rahma, A.; Elma, M.; Pratiwi, A.E.; Rampun, E.L. Performance of interlayer-free pectin template silica membranes for brackish water desalination. Membr. Technol. 2020, 2020, 7–11. [CrossRef]
19. Chua, Y.; Lin, C.X.C.; Kleitz, F.; Smart, S. Mesoporous organosilica membranes: Effects of pore geometry and calcination conditions on the mem-

brane distillation performance for desalination. Desalination 2015, 370, 53–62. [CrossRef]

20. Sumardi, A.; Elma, M.; Rampun, E.L.A.; Lestari, A.E.; Assyaifi, Z.L.; Darmawan, A.; Yanto, D.H.Y.; Syauqiah, I.; Mawaddah, Y.; Wati, L.S. Designing a mesoporous hybrid organo-silica thin film prepared from an organic catalyst. Membr. Technol. 2021, 2021, 5–8. [CrossRef]
21. Diniz da Costa, J.C.; Lu, G.Q.; Rudolph, V.; Lin, Y.S. Novel molecular sieve silica (MSS) membranes: Characterisation and permeation of single-step and two-step sol–gel membranes. J. Membr. Sci. 2002, 198, 9–21. [CrossRef]
22. Syauqiyah, I.; Elma, M.; Putra, M.D.; Rahma, A.; Pratiwi, A.E.; Rampun, E.L.A. Interlayer-free Silica-carbon Template Membranes from Pectin and P123 for Water Desalination. MATEC Web Conf. 2019, 280, 03017. [CrossRef]
23. Wojdyr, M. Fityk: A general-purpose peak fitting program. J. Appl. Crystallogr. 2010, 43, 1126–1128. [CrossRef]
24. Rahman, S.K.; Maimunawaro; Rahma, A.; Isna, S.; Elma, M. Functionalization of hybrid organosilica based membranes for water desalination—Preparation using Ethyl Silicate 40 and P123. Mater. Today Proc. 2020. [CrossRef]
25. Lin, C.X.C.; Ding, L.P.; Smart, S.; Diniz da Costa, J.C. Cobalt oxide silica membranes for desalination. J. Colloid Interface Sci. 2012, 368, 70–76. [CrossRef] [PubMed]
26. Boffa, V.; Castricum, H.L.; Garcia, R.; Schmuhl, R.; Petukhov, A.V.; Blank, D.H.A.; Elshof, J.E.t. Structure and Growth of Polymeric

Niobia-Silica Mixed-Oxide Sols for Microporous Molecular Sieving Membranes: A SAXS Study. Chem. Mater. 2009, 21, 1822–1828. [CrossRef]

27. Ayral, A.; Julbe, A.; Rouessac, V.; Roualdes, S.; Durand, J. Microporous Silica Membrane: Basic Principles and Recent Advances. In Membrane Science and Technology; Elsevier: Amsterdam, The Netherlands, 2008; Volume 13, pp. 33–79.
28. Elma, M.; Rampun, E.L.A.; Rahma, A.; Assyaifi, Z.L.; Sumardi, A.; Lestari, A.E.; Saputro, G.S.; Bilad, M.R.; Darmawan, A. Carbon templated strategies of mesoporous silica applied for water desalination: A review. J. Water Process. Eng. 2020, 38, 101520. [CrossRef]

29. Ladewig, B.P.; Tan, Y.H.; Lin, C.X.C.; Ladewig, K.; Diniz da Costa, J.C.; Smart, S. Preparation, Characterization and Performance of Templated Silica Membranes in Non-Osmotic Desalination. Materials 2011, 4, 845–856. [CrossRef]

30. Wang, D.K.; Chen, R.; Motuzas, J.; Smart, S.; Diniz da Costa, J.C. Chapter 13-Rapid Thermal Processing of Microporous Silica Membranes A2-Basile, Angelo. In Current Trends and Future Developments on (Bio-) Membranes; Ghasemzadeh, K., Ed.; Elsevier: Amsterdam, The Netherlands, 2017; pp. 317–348. [CrossRef]

31. Tsuru, T.; Igi, R.; Kanezashi, M.; Yoshioka, T.; Fujisaki, S.; Iwamoto, Y. Permeation properties of hydrogen and water vapor through porous silica membranes at high temperatures. AIChE J. 2011, 57, 618–629. [CrossRef]

32. Iler, R.K. The Chemistry of Silica: Solubility, Polymerization, Colloid and Surface Properties, and Biochemistry; Wiley: New York, NY, USA, 1979.

33. Burneau, A.; Gallas, J.-P. The Surface Properties of Silicas; Legrand, A.E., Ed.; Wiley: Chichester, UK, 1998.

34. Duke, M.C.; da Costa, J.C.D.; Do, D.D.; Gray, P.G.; Lu, G.Q. Hydrothermally robust molecular sieve silica for wet gas separation. Adv. Funct. Mater. 2006, 16, 1215–1220. [CrossRef]

35. Ayu Lestari, R.; Elma, M.; Rampun, E.L.A.; Sumardi, A.; Paramitha, A.; Eka Lestari, A.; Rabiah, S.; Assyaifi, Z.L.; Satriaji, G. Functionalization of Si-C Using TEOS (Tetra Ethyl Ortho Silica) as Precursor and Organic Catalyst. E3S Web Conf. 2020, 148, 07008. [CrossRef]

36. Elma, M.; Pratiwi, A.E.; Rahma, A.; Rampun, E.L.A.; Handayani, N. The Performance of Membranes Interlayer-Free Silica-Pectin Templated for Seawater Desalination via Pervaporation Operated at High Temperature of Feed Solution. Mater. Sci. Forum 2020, 981, 349–355. [CrossRef]

37. Pratiwi, A.E.; Elma, M.; Rahma, A.; Rampun, E.L.A.; Saputro, G.S. Deconvolution of pectin carbonised template silica thin-film: Synthesis and characterisation. Membr. Technol. 2019, 2019, 5–8. [CrossRef]

38. Park, J. Effect of Silicate Structure on Thermodynamic Properties of Calcium Silicate Melts: Quantitative Analysis of Raman Spectra. Met. Mater. Int. 2013, 19, 577–584. [CrossRef]

39. Elma, M.; Yacou, C.; da Costa, J.C.D.; Wang, D.K. Performance and Long Term Stability of Mesoporous Silica Membranes for Desalination.

Membranes 2013, 3, 136–150. [CrossRef] [PubMed]

40. Brinker, C.J.; Hurd, A.J.; Ward, K.J. Sol-Gel Science; Academic Press: New York, NY, USA, 1987; p. 23.
41. Sing, K.S.W. Adsorption methods for the characterization of porous materials. Adv. Colloid Interface Sci. 1998, 76–77, 3–11. [CrossRef]
42. Wang, D.K.; da Costa, J.C.D.; Smart, S. Development of rapid thermal processing of tubular cobalt oxide silica membranes for gas separations. J. Membr. Sci. 2014, 456, 192–201. [CrossRef]

# 24. The development of interactive multimedia learning pyramid and prism for junior high school using macromedia authorware

Juhriyansyah Dalle[1], Sutarto Hadi[2], Baharuddin[3], Nurlaila Hayati[4]

[1,2]Lambung Mangkurat, Indonesia,

[3]State University of Medan, Indonesia

[4]State Islamic University of Antasari, Banjarmasin

**ABSTRACT**

Limited access to information due to the unavailability of internet connection in remote areas of Indonesia, especially in South Kalimantan, causes low mathematics achievement of students in junior high school, so still, require offline packages of learning such as interactive multimedia learning, therefore this study aims to develop interactive multimedia learning of pyramid and prism. The research was applied Luther (1994) method that consists of six steps: concept, design, collecting material, assembly, testing, and distribution, and for the development was using Macromedia Authorware. The result is an interactive multimedia learning pyramid and prism with following the description of the steps of developments.

Keywords: interactive multimedia pyramid and prism, mathematics achievement.

## I. INTRODUCTION

The current globalization era, the development of science and technology is growing rapidly which effects of the progress or the decline of a nation. The progress can be realized in life if human resources having the ability of science and technology in any various fields. Therefore, various ways related to the improvement of the quality of human resources, especially through edu-

cation. Education can be interpreted as a process of training and teaching for individuals to achieve knowledge, understanding, skills development and behavioral ways that suit their needs. Moreover, education also is a very important factor in improving human quality.

Various efforts have been made by education managers to develop education in order to improve student learning achievement by optimizing the available educational resources. One of the goals of today's education is to provide stock so that we can function effectively in this era of technology.

Mathematics as the science underlying the development of modern technology has an important role in various disciplines and advances the human mind. In fact, mathematics is indeed considered the most difficult lesson for both children and adults (Reynolds, 2008). In Indonesia, this can be seen from the survey that conducted by Trends in International Mathematics and Science Study and by Organization for Economic Co- operation and Development by using PISA instrument, showed that the achievement of Indonesian student on mathematics are still low with ranking 45 and 69 from 55 and 65 countries (Mullis et al., 2015; OECD, 2017).

The successful of mathematics learning process during this time is still experiencing many obstacles because of the dominance of teachers in learning is still high, the lack of use of media and props (Fitriah, 2011). In the delivery of learning, teachers pay less attention to the use of learning media to help students understand the concept of mathematics (Anggraeni, 2012).

Mathematics consists of four aspects: algebra, arithmetic, geometry, and analysis. Geometry has been taught since elementary school, but it turns out students' ability in solving three-dimensional problems are still low (Fitriana, 2010). In fact, this material is very important to learn the next material on a higher level of education.

In the three-dimensional learning process, teachers typically use three-dimensional learning media that has been provided in schools such as props pyramid and prism made of wood or other concrete objects. However, not many teachers utilize existing technology in delivering learning materials whereas today's technology has contributed greatly to providing educational media in education.

Information and Communication Technology (ICT) has spread to almost every aspect including the world of education (Neo & Neo, 2014). One technology that developed in the world of education is multimedia technology which has a very important role in the learning process (Mumpuni, 2013). It is

expected that multimedia can bring a positive impact on classroom learning that can bring learning into an active, fun and effective and can overcome the problems that we have often encountered in the world of education, especially mathematics subjects.

Multimedia is a way to produce and deliver learning materials by combining several types of computer-controlled media where the interactive multimedia program is one of computer-based learning media that combines and synergizes all media consisting of text, graphics, photos, videos, animations, music, narration and interactivity programmed by theory and principles of learning (Warsita, 2008).

One of the computer programs that support for making interactive multimedia learning is Macromedia Authorware. Macromedia Authorware is a multimedia software that integrates with global network internet with graphical display sound, digital movie, video and interaction buttons that can generate its own attraction (Adjarriawan, 2011).

Limited access to information due to the unavailability of internet connection in remote areas of Indonesia, especially in South Kalimantan and regarding to the background, it is important for researchers to contribute in providing an interactive multimedia learning, especially for the pyramid and prism material which created by using Macromedia Authorware.

## II. LITERATURE REVIEW

Multimedia Learning

Multimedia learning is a multimedia application used in the learning process, in other words, to channel the message (knowledge, skills, and attitudes) and can stimulate thoughts, feelings, attention and willingness to learn so intentionally the learning process occurs, aimed and controlled (Ariani & Haryanto, 2010). While the interactive multimedia is a multimedia display designed by the designer so that it can meet the function of informing the message and has interactivity to its users (Munir, 2012).

Multimedia interactive learning has its own characteristics such as having more than one convergent media (can combine audio and visual elements), interactive, has the ability to accommodate user responses, is self-contained, provides convenience and completeness of the content so that users can use without the guidance of others.

In addition, interactive multimedia learning should meet the following functions: be able to strengthen user response as quickly and often as possible; able to provide opportunities for learners to control their own pace of learning; notice that learners follow a coherent and controlled sequence; and able to provide opportunities for participation of users in the form of responses, either in the form of answers, selection, decisions, experiments, and others. The interactive multimedia learning capabilities of interactive multimedia have several capabilities not shared by other media; multimedia provides an interactive process and provides ease of feedback, giving multimedia freedom to learners in determining the topic of the learning process, giving multimedia ease of systematic control in the learning process (Lee, 1999).

The benefits that can be gained from the interactive multimedia learning is the learning process is clearly more interesting, more interactive, the amount of teaching time (lectures) can be reduced, the quality of student learning can be more motivated and boosted and learning can be done anywhere and anytime (very flexible), as well as student attitudes and attention can be improved and centered (Ariani & Haryanto, 2010).

Text Design and Multimedia Learning Layout

The text is a learning multimedia component that is very important in delivering a learning message. For that the use of text in the development of multimedia applications need to pay attention to the way or technique that is the use of concise but solid text, use the appropriate typeface and font, make sure the text can be read, the selection of writing style and text color and the selection of fonts and concepts consistently (Munir, 2012).

Some considerations of text design in multimedia view, among others (Marzuki, 2009):

a. Consider formatting, a text designed for easy reading.
b. Text design is a visual hierarchy; people tend to read the largest element, then the smallest.
c. The text arrangement should improve readability.
d. All factors of letter spacing, word spacing, and line spacing are easy to read, communicative and expressive.
e. Consider using letters, use original characters, and think about positive/ negative spaces.

f. When mixing the text surface, it must be ethnically adapted to the message, contrast, weight, scale and visual hierarchy.

g. Avoid anything new or decorative typeface.

Munir (2012) explains that to create text in the development of multimedia products there are several ways that can be used include:

a. Be careful in choosing the appropriate font type so that the display on the computer screen is not hard to read.

b. Use of large number faces of font type on one screen should be minimized.

c. Spacing the characters, lines, and spacing between text and text with other objects such as images.

d. Use text of any size, type, thickness, and so on to deliver messages to attract more users and should use larger text and bold fonts.

e. Use white text if the background is black or dark and avoid using the same color or color mix that resembles the background color.

In addition to text, another thing to note is the layout (layout) multimedia. Layout (layout) is the placement of text, images, audio, video, and animation as a multimedia display of learning (Marzuki, 2009). The placement of multimedia elements greatly affects messages or information visualized because of improper placements the impression is unattractive; otherwise, the perfect placement will give the impression that multimedia display is interesting (Marzuki, 2009).

Implementation of all layers visualized with the same concept (not exactly execution), in the design of visual communication this is called unity, which uses the audio and visual language harmonious, intact and matching so that the teaching materials are perceived as intact (Marzuki, 2009). To help the execution of layout can be made grid system, that is division of field according to ergonomic element functions, for example laying of navigation adjusted with mean of command of navigation, navigation 'next' placed on the right and 'back' placed on the left and so forth (Marzuki, 2009).

Preparation of the text is consistently left, right, or symmetrical depending on the desired concept, but the left flat layout tends to give the impression of informal and flowing, left- right average more formal and rigid impression, and symmetrical memorable very formal and the layout is made more for the purpose of adding value to the communicative aspects of multimedia learn-

ing, not for beauty alone (Marzuki, 2009).

As a first step, you should create a simple layout, so that visualization is not complicated to reduce noise on the clarity of the content of teaching materials and also intended for the subject matter easy to remember and the layout is expected to meet the aesthetic rules, among others: the composition is maintained and produces rhythm, balance, and controlled harmony. Keeping the simplicity can be done by choosing the right graphics layout, minimal and matching according to the character of information and pay attention to the closeness of the layout to the characters/habits of the target or the tastes of students who are in most of the young dynamic spirited and in preparing the layout of the multimedia display of learning need to consider the principles of balance, contrast, harmony, proximity, and repetition (Marzuki, 2009).

Macromedia Authorware

Authorware is multimedia software that integrates with global internet network with graphical display of sound, digital movie, video and interaction buttons that can generate its own attraction (Adjarriawan, 2011). Authorware is used to create interactive programs that integrate various multimedia content (Wikipedia, 2012). Currently, Authorware 7.0 has two choices of programming languages namely Authorware programming languages and JavaScript language version 1.5. The use of icons and the flow line under which Authorware is operated makes it easy to create interesting tutorial applications. The use of a flow line differentiates Authorware from other authoring programs, such as Adobe Flash and Adobe Director that rely on visual timelines and action scripts

## III. RESEARCH METHODOLOGY

This research was applying Luther (1994) method which then modified by Sutopo (2009) into six stages: concept, design, collecting material, assembly, testing, and distribution as explained below:

1) Concept

Stage of concept making is the initial stage in making multimedia-based learning media. What is done in this concept stage is the determination of the purpose of the use of instructional media, determining who can use this learning media and analyze the extent to which the material will be applied in this multimedia learning.

2) Design

In the design stage, is to specify in detail about the structure of media, style, and material needed. In this design phase begins by arranging the order of presentation and arranging the flow of learning flowchart. This is done in order to make multimedia learning more focused.

The steps of design include: writing the script material that will be made as a multimedia learning, composing the contents of the outline in the media learning, storyboard making, arranging the flow of learning in the form of a flowchart, and the design of learning media layout. The design of media layout done with the help of some image editor such as Adobe Photoshop 7.0 and Paint.

3) Material collecting

This stage is the stage of collecting materials and also the advanced stage of the design stage. The sequence in the process of collecting materials includes the collection of materials needed for multimedia learning such as animation, music, video, and images. For animation and video creation, researchers use some supporting software such as Macromedia Flash MX, Macromedia Flash 8, Swish Max 4.0, Adobe Flash CS4, and Anim FX and development of test questions (Competency Test) which further compilation of test instruments pay attention to several things, referring to education unit level curriculum, assessments viewed from the cognitive aspect, the items are multiple choice items.

4) Assembly

Assembly is the stage where all multimedia objects are created or inserted into each frame called screen mapping. The steps taken in the manufacture of the media begin by integrating all the material that has been made into the layout according to the storyboard and transfer all the components that have been made into the screen mapping by using flow line on the Macromedia Authorware program.

5) Testing

Stage testing is done by running the application for errors tracer for application improvement (Sutopo, 2009). In this study, testing is done by using black box testing for testing some functions that were wrong or missing, interface design, or other performance errors.

Black box testing is to see whether all the device functions are running properly according to the defined functional requirements (Pressman & Maxim, 2014). Black box testing is done to 2 teachers of mathematics subjects and 72 students of grade VIII of Madrasah Tsanawiyah Hidayatullah Banjarmasin South Kalimantan Indonesia. Black box testing focuses on Interactive Learning Multimedia error searching. Black box testing performed on testing system functionality including buttons, interface design, animation and material that is displayed is in accordance with the standard GUI (Graphical User Interface) that allows users to interact with the computer. If all the buttons on the Interactive Learning Multimedia being tested can run as expected then this interactive multimedia learning can be said to fulfill the GUI.

6) Distribution

In the Luther method, this stage is the stage of distribution or stage of program sales. However, in the Luther-Sutopo method (Sutopo, 2009), this stage is modified into a multimedia distribution or packing stage into a storage medium. In this research, storage media is CD.

Multimedia packaging is done after this interactive multimedia learning is published in the form of .exe for subsequent burning into CD.

## IV. RESULTS AND DISCUSSION

Developing interactive multimedia learning of pyramid and prism material for VIII grade the 2nd grade of Junior high school is done with multimedia development procedure. The design of this research is done through six stages: the concept of concept, design, collecting material, assembly, testing, and distribution (Luther, 1994).

The researcher's concepts include determining the purpose of using instructional media, determining the objectives in making instructional media, analyzing the extent to which the material will be applied, and determining the competence standard, basic competence and the material indicator that will be applied in this learning multimedia. From the results of material analysis obtained two sub-materials that will be delivered in this interactive learning multimedia that is pyramid and prism. Each sub-material is divided into 4 parts namely understanding, painting, surface area, and volume.

The results of research on the design of interactive multimedia learning include narrative script, storyboard, flowchart and layout of learning media.

Based on the script written then this interactive learning CD is divided into three parts, namely:

1) The initial (preliminary) section consists of intros and preliminary menus.
2) The core consists of several parts of the menu are figures, menu materials, competency test menu, glossary menu, and menu list of libraries, and profiles of researchers.
3) The cover contains an exit menu. As for designing layout of this interactive learning CD, the researcher uses adobe Photoshop 7.0 software. This application is used for processing images that will be imported into Macromedia Authorware to be used as background, buttons, and text that will be used in this learning CD also made using adobe Photoshop. Here are the layout design results:


Capture 1. Background Main Page


Capture 2. Design of information on interactive multimedia learning CD package


Capture 3. Samples of buttons and their response

At the collecting material stage, the collection of video, animation, instrumental music and the results of the development of test instruments that have been tested and then will be applied to interactive multimedia learning.

A testing instrument that tested there is two packages questions that are a package of questions A and a packages questions B, each package consisting of 30 multiple choice questions which then analyzed the validity, reliability, difficulty level, and discrimination. At the assembly stage, media creation is done gradually. Making learning media applications based on the storyboard, flowchart view, navigation structure or object diagram comes from the design stage. These interactive learning multimedia is created using Macromedia Authorware 7.0 as the main software. Making interactive multimedia learning in Macromedia Authorware 7.0 using a flow line system that can facilitate the process of importing animations, music, videos, exercise questions, navigation systems and so forth into the work area Macromedia Authorware 7.0.

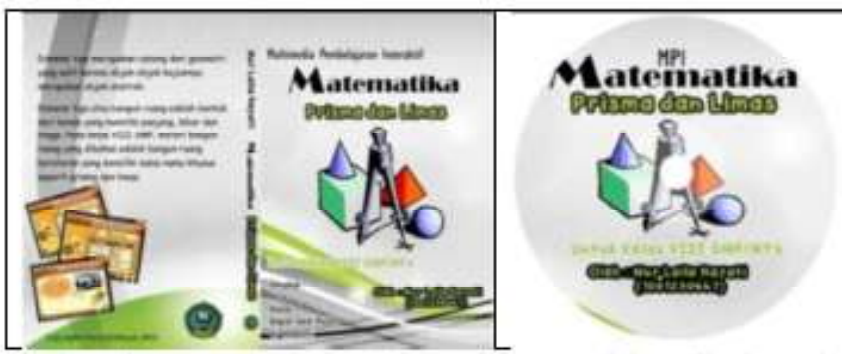
Macromedia Authorware 7.0 also cannot be separated from the programming language used to run program commands. The existing programming languages in Macromedia Authorware 7.0 are Authorware and JavaScript. In this case, researchers use an Authorware language that can facilitate the creation of programming commands. A programming language is used when making the contents of the menu "competency test" in which there is a process of

giving time to do problems and the process of scoring and used on the menu "out" to give commands to the program to end the interactive multimedia learning applications.

Each page in this interactive multimedia learning consists of title text animation, text animation and provided a navigation button that links one page to other pages like next to next page, back to page previous and buttons to the main page.

Black box testing results performed on testing system functionality including interface design, animation, and material that is displayed is in accordance with the standard graphical user interface (GUI) so as to facilitate the user in interacting with the computer. Based on the results of black box testing, it can be concluded that the standard GUI all the buttons can function in accordance with the order that has been designed.

After testing, the next process is to save the file in the form *.exe then packaged in the form of CD learning that is run by using CD-ROM. Here is the label design and cover CD-ROM.




In general, developed multimedia focuses on the activities of students in using it; therefore this learning media contains problems related to pyramid and prism material. For that, interactive multimedia learning is ready for use by teachers and students.

Before students or teachers using this interactive multimedia learning CD, at the first they have to know the computer specifications that support to run this program and how to use it. This application has a capacity of 98.3 MB and the minimum requirement to run this interactive CD is Intel Pentium II or more

computers with 32 MB memory, 120 MB free hard drive capacity, Windows operating system, 800x600 resolution (SVGA) and a CD ROM drive.

This interactive multimedia learning CD is very easy to use because the program comes with a help menu and instructions that appear each time the cursor is directed to a button that is either icon or text. To enter into this interactive learning multimedia program, simply select this program insert the CD ROM folder, then press enter or double-click.

## V. CONCLUSION AND RECOMENDATION

Making interactive multimedia learning using Macromedia Authorware on pyramid and prism material is done in six stages: concept, design, collecting material, assembly, testing, and distribution. In the concept stage, the objective is determined that this research produces an interactive multimedia learning product in the form of learning CD prism and pyramid of class VIII which can be used by teachers and students as learning media of pyramid and prism.

In the design stage, the results obtained are manuscript produced in the form of analysis of pyramid and prism material, storyboard produced in the form of detailed explanation for each interactive multimedia learning view, the flowchart in the form of the whole learning path in instructional media, and interactive multimedia learning layout design. In the material collecting stage, the results obtained are collecting materials of pyramid and prism which will be displayed in the media in the form of animation, image, video, and music. While at the stage of assembly, all the materials that have been collected processed using Macromedia Authorware program and media results include nine main menus that are The preliminary menu, character, material, competency test, glossary, bibliography, help, profile, and exit.

At the testing, the stage is done by black box method stating that all the buttons can function in accordance with the order that has been designed. The distribution stage is done by packaging process of interactive multimedia learning of pyramid and prism into the form of learning CD.

In the next research is expected to develop an integrated interactive multimedia learning with the model and equipped with games that

match the material being taught. Multimedia interactive learning is basically an early development, to furthermore is expected to be tested to the user (student or teacher) to obtain an input to improve the interactive multimedia learning.

## REFFERENCES


Adjarriawan, R. (2011). Interactive multimedia module using macromedia authorware. Martapura: SMKN 1 Martapura.

Anggraeni, R. R. W. P. (2012). Development of multimedia web-based e-learning development courses on the education technology undergraduate Universitas Negeri Yogyakarta. Master thesis, Universitas Negeri Yogyakarta. Retrieved September 26, 2017, from http://eprints.uny.ac.id/8391/

Ariani, N., & Haryanto, D. (2010). Multimedia learning at school. Jakarta: Prestasi Pustaka.

Fitriana, L. (2010). Influence of cooperative learning model type group investigation and stad on mathematics learning achievement in terms of student learning independence. Surakarta: Digital Library Universitas Sebelas Maret.

Fitriah, A. (2011). Comparison of combinations of bamboo dance techniques and multimedia animation with bamboo dance techniques without multimedia animation on generic science skills in students. Retrieved September 2, 2017, from http://digilab.unila.ac.id

Lee. S. H. (1999). Usability testing for developing effective interactive multimedia software: Concepts, dimensions, and procedures. Journal of Educational Technology & Society, 2(2). Retrieved from http://www.jstor.org/stable/jeductechsoci.2.2.4

Luther, A. C. (1994), Authoring interactive multimedia, AP Professional, Cambridge, MA

Marzuki, R. (2009). Multimedia learning evaluation techniques (text design and multimedia learning layout). Jakarta: Genius Prima Media.

Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2015). TIMSS 2015 International results in mathematics. Retrieved September, 26, 2017. from https://timssandpirls.bc.edu/

Mumpuni, R. H. (2013). Development of learning media of social arithmetic based on edutainment to facilitate the creation of active, joyfull, effective learning (AJEL) of students at junior high school seventh grade. Yogyakarta: Digital Library UIN Sunan Kalijaga.

Munir. (2012). Multimeda concepts & applications in education. Bandung: Alfabeta.

Neo, M., & Neo, T-K. (2010). Students' perceptions in developing a multimedia project within a constructivist learning environment: A Malaysian experience. The Turkish Online Journal of Educational Technology (TOJET). 9(1). 176-184.

OECD. (2017). Education at a Glance 2017. Retrivied September, 26, 2017 from http://www.oecd.org

Pressman, R. S., & Maxim, B. (2014). Software engineering: A practitioner's approach.

8th edition. McGraw-Hill Education

Reynolds, D. M. (2008). Effective teaching. Yogyakarta: Pustaka Pelajar.

Sutopo, H. (2009). Development of learning model of making multimedia application especially puzzle game in multimedia course. Jakarta, Indonesia: Digital Library Program Pascasarjana Universitas Negeri Jakarta.

Warsita, B. (2008). Learning technology, grounding and its application. Jakarta: Rineka Cipta.

Wikipedia. (2012). Adobe authorware. Retrieved September 17, 2017, from https://en.wikipedia.org/wiki/Adobe_Authorware

# 25. Adoption of e-Learning in Indonesian Higher Education: Innovation or Irritation?

Herry Porda Nugroho Putro, Sutarto Hadi, Ismi Rajiani, Ersis Warmansyah Abbas, Mutiani

Universitas Lambung Mangkurat, Indonesia

**ABSTRACT**

Advancement of information technology has led a growing number of companies to use a digital approach to learning management. Indonesian universities are following the trend by adopting e-learning to boost lecturers' performance. However, e-learning is not without challenges and failures for the technology cannot be perceived as a solution to all problems. This study investigated the influential adoption factors to adopt e-learning in higher education from the perspective of technology, people and organization. The empirical data, which consisted of 320 valid datasets were collected from lecturers in Indonesia via a self-administered paper-based questionnaire, and Structural Equation Modelling (SEM) was employed to analyze the collected data. The finding of this research advanced our understanding of the dynamics of elearning and refined the existing conclusions about perspectives of educators towards the adoption process of e-learning. Further, the current gaps between developed and developing countries on the adoption of e-learning provide an original reference on how technology, organization, and people sides influence the individuals' behaviors when adopting new technology.

Keywords E-learning, technology, performance, lecturer, Indonesia.

## I. INTRODUCTION

The rapid progression of information technology (IT) has created a learning environment in universities conducive to a digital era. The challenges and opportunities of applying IT make both researchers and practitioners focus

progressively on the integration of IT with learning systems known as e-learning (Julia & Marco, 2021). Thus, traditionally considered as a supporting role to deliver teaching services (Sarbaini et al., 2019), e-learning is currently leading the digital transformation providing competitive advantage to the universities (Netanda et al., 2019). E-learning is a common terminology that covers all possible juxtapositions between performing learning and technology (Rafiee & Abbasian-Naghneh, 2021). E-learning is also regarded as a tool for increasing instructional efficiency, examining the consequences of e-learning application and revealing factors supporting or inhibiting the adoption of e-learning.

Past studies have expressed confidence on the prospects of e-learning improving instructional efficiency (Beinicke & Kyndt, 2020; Wang et al., 2021). The empirical evidence displays various apprehensions that the adoption of IT does not always result in better learning outcomes. For instance, Zalazar-Jaime et al. (2021) found out that instead of freeing up the time of lecturers, the implementation of e-learning merely headed to an escalation in technology-related activities replacing administrative matters, without any enhancement in learners' satisfaction. A different point of view is also observable where some scholars assume technological determinism Szablewicz (2020) where they conceptualize technology at the first level and downplay the significance of vital social processes in producing organizational outcomes and regard the actors' attitudes and behaviors is functional and following established model. On the other hand, some studies take for granted the superiority of human activities over technology (Fregnan et al., 2020). The first stream, technological determinism, reflects an underlying positivist paradigm in which technology is a distinct independent measurable variable that has predictive consequences in organizations. The second stream treats technology as an emergent concept that evolves over time and context and thus reflects a more post-positivism perspective.

Indonesia as a developing country is technologically qualified and well-prepared for implementing elearning in public universities (Sarbaini et al., 2019). However, the adoption of e-learning in Indonesia has not been acknowledged at this point to the degree and impact similar with developed countries or some developing countries. One of the essential reasons that e-learning has not been to a great extent grasped in Indonesia is the absence of adequate imminent examinations dedicated to figure out what variables drive and impact client's observations and points of view towards selection of e-learning advancements. Existing research has examined a relationship between e-learning and the quality

of instruction Rahayu (2021) neglecting the effect of e-learning practices on university-level outcomes, such as lecturers' performance. Moreover, the existing e-learning models have been established in Europe and the United States reflecting westerners' practices and beliefs. Till date, very little is known about the use of e-learning and its impact on higher education outcomes particularly in South East Asia. Therefore, this research aims to fill this gap by investigating e-learning practices to improve lecturers' performance in operationally, relationally, and transformational manner in the workplaces of state universities in Indonesia by integrating technology factors, organization factors, and people factors.

This study comprises five parts. Subsequent to the introduction, the second part reviews previous studies to show the association between technology acceptance, organizational resources, employees' knowledge, elearning adoption, and transformational performance. The focus isto prioritize on the readinessto adopt e-learning to boost lecturers' transformational performance. This literature review section also guided the generating of hypotheses of the study. The third part describes research design, research methodology, data collection methods and other techniques of data analysis used in the study. The fourth part explains the findings and results and discusses the data generated on the association between technology acceptance, organizational resources, employees' knowledge, e-learning adoption, and transformational performance within Indonesian university settings. The last section is the conclusion showing implications and future research as well.

## II. LITERATURE REVIEW

1. E-learning

E-learning is integration between mechanisms and contents of learning and Information Technologies (Shin, 2019). Researchers studying the effects of IT on learning have defined e-learning as 'the (planning, implementation and) application of IT for both networking and supporting at least two individual or collective actors in their shared performing of teaching activities' (Pretorius et al., 2019; Yang et al., 2021). More recently, it is described as 'the application of computers and telecommunication devices to collect, store, retrieve, and disseminate learning material for instructional purposes' (Garzón-Artacho et al., 2021). Researchers studying IT-enabled changes in the learning function have chosen to define e-learning as 'the administrative support of the learning

function in educational organizations by using internet technology' (Julia & Marco, 2021); or being 'a way of implementing learning strategies, policies, and practices in organizations through the conscious and direct support of and/ or with the full use of channels based on web-technologies' (Alsahlawi, 2021; Baydar & CETIN, 2021; Hamsal et al., 2021; Martini et al., 2020).

Thus, we define e-learning in this study as the integration of IT and the instructional field of scholarly inquiry emphasizing all the teaching-and-learning content shared through IT that aims to make learning processes distinctive and consistent, more efficient across organizations for targeted users. Past literature has also suggested that e-learning has the potential to improve instructional service quality (Jordaan & Coetzee, 2021; Szablewicz, 2020), which is adhered upon in this study.

2. Technology acceptance

Sayeed and Onetti (2018) claimed that factors impacting e-learning adoption could be theoretically categorized into technology, organization, and people factors. E-learning as a field of study is built around technology, prioritizing the discovery of its implementation consequences for learning interaction and practices.

Empirical studies on e-learning rarely make a difference between technology and the notion of e-learning (Julia & Marco, 2021), analyzing it as an organizational-level that incorporates everything and everyone into some system (Rajiani & Ismail, 2019). The technology acceptance model suggests that actual usage behavior is dependent on the intention to use a technology as well as the attitude towards the system (Arfi et al., 2021). To supply extra readability about the e-learning concept as a configuration of the hardware, software and verbal exchange technology, Szablewicz (2020) identified IT as a physical entity separated from people but comprises organizational processes. From this perspective, technology is regarded as an entity carrying out organizational processes, whilst actors' behavior can be decided by recognized e-processes. The technical attributes of a new IT system significantly impact the end-users' acceptance (Harlie et al., 2019). Prior studies point out that users' genuine adoption conduct in the direction of a given technology and system is envisioned by external variables such as users' appreciation of the new technology (Lipinska, 2021; Sarbaini et al., 2019). Since the characteristics of a technology are the essential determinants of users' attitudes, this study argues that users' grasp of the usefulness of an e-learning device may impact

their adoption intention. The system usefulness of e-learning refers to advantages customers count on to receive from utilizing e-learning structures to their everyday work (Arfi et al., 2021). The unified theory of acceptance and use of technology (UTAUT) model is the most widely used with respect to the user's acceptance of technology in university setting (Al-Sharah et al., 2021; Harlie et al., 2019).

Under UTAUT, technology acceptance is determined with performance expectancy, effort expectancy, social influence, and facilitating conditions. Therefore, we hypothesize the following:

H1: Technology acceptance is positively related to e-learning adoption.

3. Organizational resources

Drawing from resource-based view (RBV) perspective, certain types of resources owned and controlled by universities have the potential and promise to generate competitive advantage which eventually leads to superior higher educational performance (Rajiani & Ismail, 2019). An emphasis is given on organizational resources as they are positively associated to e-learning adoption. Universities with adequate resources are more prospective to afford facilitating conditions for e-learning adoption such IT infrastructure, training, and technical support (Harlie et al., 2019), which could enhance e-learning adoption in organizations for the following reasons.

There are a few benefits of making use of IT as an organizational resource. First, as a precarious organizational resource, a well-designed IT infrastructure of a company provides the foundation for the organization to implement e-learning (Kokoç & Altun, 2021). Second, sufficient training in e-learning provides faculty a deeper understanding of the importance of e-learning adoption and makes them more proficient in the relevant functions which boost their intention to adopt e-learning (Kaizer et al., 2020). Third, a strong technical support enables specialized academic staff to solve problems resulting from e-learning utilization. As a sign of organizational effort to implement e-learning, technical support develops user satisfaction with e-learning systems and the adoption process (Hamel, 2021; Yamoah, 2020). Therefore, we hypothesize the following:

H2: Organizational resources are positively associated with e-learning adoption.

4. Employees' knowledge

Another potential problem found in people' side of e-learning adoption is the users' knowledge. It is contended that faculty with ample acquaintance are more prospective to accept new technologies such as e-learning systems.

They possess sufficient knowledge and have a higher wisdom of technological self-efficacy (Al-Debei et al., 2021; Alnoor et al., 2020). They are confident that they are able to use the information system properly, and their sensitivity to the ease of use of e-learning systems is high. Further, individuals with sufficient knowledge incline to identify the prospect of technology and appreciate the tangible value of information systems making them willing to try new alternatives of e-learning (Kapo et al., 2020). Since perceived ease of use turns as a critical cause of technology acceptance, knowledgeable employees are more probable to adopt e-learning (Yuen et al., 2021). Based on the above, we propose:

H3: Lecturer's knowledge is positively related to e-learning adoption.

5. Transformational Performance

Agreeing with the work of Bissola and Imperatori (2013), e-learning can be clustered into operational, relational, and transformational e-learning practices. Operational e-learning practices are related to the administrative role of the learning function. Such practices are commonly called obligatory because these practices are usually compulsory for the presence of e-learning practice (Martini et al., 2020). Relational elearning practices are concentrated on inter-personal relationships. The objective of such practices is first, to improve the quality of e-learning services, and second, to guarantee procedural and organizational implementation (Agarwal & Lenka, 2018). Transformational e-learning concerns with a strategic character to line up lecturers' attitudes and behavior with the organization's strategy (Kuechler & Stedham, 2018). These practices do not always accentuate lecturer's outcomes directly, but usually aim to align lecturer's behavior with university outcomes. Such a consideration is relevant for public universities in Indonesia currently struggling with strategic ambiguity as they want to mix educational accomplishments to maintain institutional identity and standing, but simultaneously to decentralize to occupy a captive market and generate revenue (Rajiani & Ismail, 2019). Based on the above, we propose the following:

H4: e-learning adoption is positively associated with transformational performance.

## III. METHODE

Sample

A sample of 500 public university lecturers from South Kalimantan Province, Indonesia was selected for this study. The sample selection method applied purposive sampling based on the willingness of the members to join a WhatsApp social media group in order to participate in this research. The study was carried out from January to July 2021. Out of the 500 questionnaires sent, only 320 valid questionnaires were used for analysis which represented about 64 percent response rate.

Instruments

Data collected was carried out by disseminating online questionnaires to assess the opinions of each participant toward each statement related to the topics. Due to strict rules imposed by the local government on outdoor movement and observe social distancing during the pandemic, online questionnaires were the only mode feasible for data collection.

Procedure

This study used a quantitative method to test and identify variable dependency (Kot & Rajiani, 2020). This method is useful particularly in analyzing the interaction of technology factors, organization factors, and people factors toward adoption of e-learning in achieving transformational performance obtained through questionnaires. Respondents reported their level of agreement with each item using five-point Likert-type scale (1–strongly disagree; 5–strongly agree).

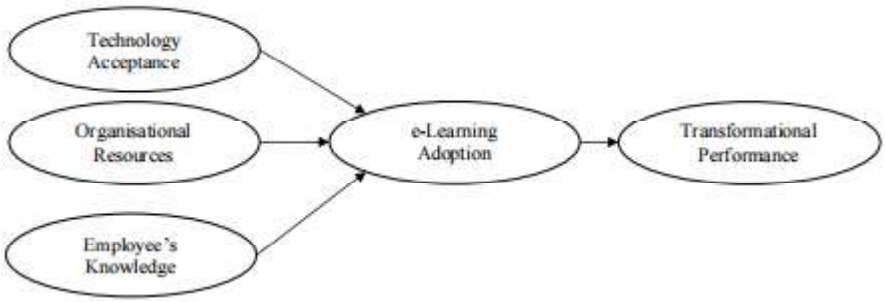
Data analysis

This research employed Covariance Base (CB) -SEM application with the aid of SPSS AMOS software for data analysis and to scrutinize the relationship among the variables. The CB -SEM was applied in the model as there are existing theories to test (Hair Jr et al., 2020). The model consists of three endogen variables which are technology acceptance (TA) with four items from (Venkatesh, 2021), organizational resources (OR) with four items Sayeed and Onetti (2018), and employees' knowledge (EK) with five items (Berkowsky et al., 2017).

Furthermore, e-learning adoption (EA) with three items (Venkatesh, 2021), and transformational performance (TP) with three items Lepak et al. (2005) served as endogen variables. The items for transformational performance (TP) were knowledge management, organizational development, and strategic

planning. These variables are displayed in Figure 1.

Figure 1. Theoretical Model of the study




## RESULTS

This section presents the results of the questionnaires as retrieved from the responses of the participants on adoption of e-learning toward the transformational performance of universities. Table 1 examines the convergent validity of the questionnaire indicating the association among items. To evaluate discriminant validity, the authors applied a factor loading model where only items with factor loading surpassed 0.50 stayed in the model (Hair Jr et al., 2020). The coefficient alpha was examined to determine reliability, and those values must be 0.60 or higher (Bonett & Wright, 2015).

Table 1. Convergent Validity

| Construct | Loading Factors | Cronbach Alpha | Means |
|---|---|---|---|
| TA1<--- Technology Acceptance | 0.805 | | 4.4 |
| TA2<--- Technology Acceptance | 0.731 | 0.967 | 4.2 |
| TA 3<--- Technology Acceptance | 0.814 | | 4.5 |
| TA4<--- Technology Acceptance | 0.842 | | 4.5 |
| OR1<--- Organizational Resources | 0.721 | | 4.3 |
| OR 2<--- Organizational Resources | 0.712 | 0.831 | 4.0 |
| OR 3<--- Organizational Resources | 0.781 | | 4.5 |
| OR 4<--- Organizational Resources | 0.679 | | 3.5 |
| EK1<--- Employees Knowledge | 0.732 | | 4.4 |
| EK.2<--- Employees Knowledge | 0.764 | 0.867 | 4.5 |
| EK 3<--- Employees Knowledge | 0.678 | | 3.8 |
| EK4<--- Employees Knowledge | 0.792 | | 4.5 |
| EK 5<--- Employees Knowledge | 0.675 | | 3.5 |
| EA1<--- e-learning adoption | 0.704 | | 4.1 |
| EA2<--- e-learning adoption | 0.721 | 0.832 | 4.3 |
| EA3<--- e-learning adoption | 0.804 | | 4.5 |
| TP1 <--- Transformational Performance | 0.897 | | 4.5 |
| TP2 <--- Transformational Performance | 0.872 | 0.865 | 4.2 |
| TP3 <--- Transformational Performance | 0.860 | | 2.5 |

The measurement model in Table 1 is evident of the loading factors which are above 0.50 signifying that the convergent validity of instrument is satisfactory. Table 1 also displays the result of Cronbach alpha coefficients for the instrument surpassing 0.60, which is the threshold for accepted reliability.

A full specified model of the current research is presented in Figure 2. The SEM demands small value for Chi-square statistic (?2) and probability (P) smaller than 0.05. Though these statistics are usually conveyed in structural equation modelling results, they are rarely considered and generally unnoticed as researchers prefer to other alternative measurements to evaluate the model fit (Alavi et al., 2020). The justification is that Chisquare statistic (?2) and probability (P) are strictly connected to sample size: the bigger is the sample, the smaller are the Chi-square statistics and the higher is the probability. Hu and Bentler (1999) had contended that limits approximate to 0.95 for Tucker-Lewis Index (TLI), 0.90 for Norm Fit Index (NFI), 0.90 for Incremental Fit Index (IFI), 0.06 for Root Mean Square Error of Approximation (RMSEA) sufficiently substantiate the acceptance of a precise fit between the suggested model and the data.

Other researchers have suggested goodness-of-fit statistics containing CMIN/DF (The Minimum Sample Discrepancy Function) expected = 2.0 (Arbuckle, 2011); GFI (Goodness-of-Fit Index) approaching 0.90 and AGFI (Adjusted Goodness-of-Fit Index) close to 0. 90 or greater (Hair et al., 2020). By referring to the ?2 test (?2 = 15.863) and probability (P = 0.10), this model do not meet goodness-of-fit of the model. But when examined from other measurement, the model indicates an appropriate fitness: CMIN/DF = 1.687 (expected smaller than 2), GFI = 0.983 (higher than 0.90), AGFI = 0.998 (higher than 0.90), CFI = 0.985 (higher than 0.95), TLI = 0.987 (higher than 0.95) and RMSEA = 0.086 (higher than 0.08).

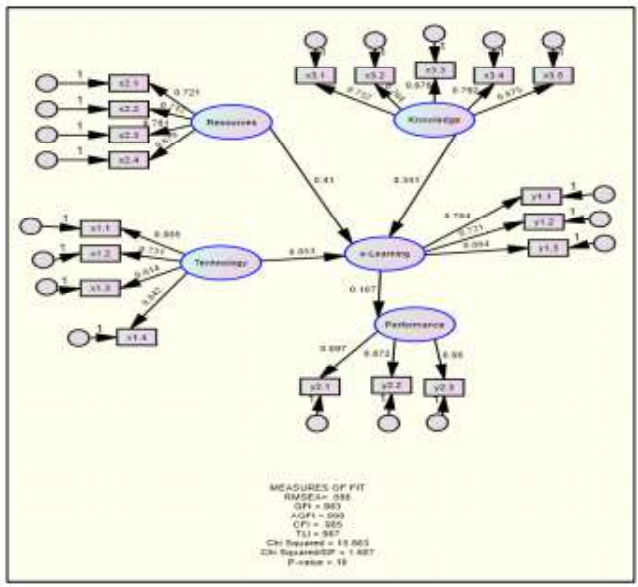



Figure 2. Measurement Model Assessment

The summary result of structural equation modelling is presented in Table 3. The results indicate that three paths are significant and one path is not.

| Constructs | Estimate | SE. | CR. | P | Conclusion |
|---|---|---|---|---|---|
| Technology acceptance → e-learning | 0.897 | 0.132 | 10.134 | *** | Significant |
| Organizational Resources → e-learning | 0.410 | 0.210 | 7.503 | *** | Significant |
| Employees Knowledge → e-learning | 0.341 | 0.171 | 4.306 | 0.04 | Significant |
| e-learning → Performance | 0.107 | 0.311 | 0.124 | 0.213 | Not Significant |

Notes: *** = p < 0.00.

Table 3. Path Analysis

The critical ratio (CR) value of technology acceptance = 10.134 and significance of < 0.000 confirm the first hypothesis: technology acceptance is positively related to e-learning adoption. Similarly, the critical ratio (CR) of organizational resources = 7.503 and significance of < 0.000 confirm the second hypothesis: organizational resources are positively associated with e-learning adopton. Also, the critical ratio (CR) value of employees' knowledge = 0.341 and significance of 0.04 confirm the third hypothesis that employees' knowledge

is positively related to e-learning adoption. However, the significance level of e-learning to transformational performance = 0.213 > 0.05 rejects the fourth hypothesis that e-learning adoption is positively associated with transformational performance.

## IV. DISCUSSION

Technological optimistic views propose that the IT opportunities for e-learning are never-ending: fundamentally all learning innovation can be reinforced by IT (Szablewicz, 2020). The results support this notion indicating that Indonesian universities have implemented HR strategies, policies, and practices in organizations through a mindful and engaged support with the full use of web technology. In other words, Indonesian public universities have shifted classical human resources management in terms of recruitment, selection, development, compensation, retention, evaluation, and promotion of personnel within an organization into virtual world.

The results also support the previous research that Indonesia is technologically qualified and wellprepared for implementing e-learning in public and business organizations to improve service quality (Rajiani & Ismail, 2019; Sarbaini et al., 2019). However, the practices are impliedly related to operational e-learning (Means = 4.5) concern the basic e-learning activities in the administrative areas like informing the absence of lecturers and personnel data administration and relational e-learning. The result (Means =4.2) concern activities supporting basic learning processes such as recruiting and the selection of new class leaders, delivering lecture, performance management and appraisal, and rewards for students. Contrary to the findings in developed countries (Martini et al., 2020) and in line with studies in other developing countries (Ibrahim, 2021), it is estimated that e-learning cannot lead Indonesian universities to transformational practices (Means = 2.5). These activities are related to organizational change processes, strategic re-orientation, strategic competence management, and strategic knowledge management.

Indonesian universities have responded the rapid growth of technology by innovating both in technology and management which inevitably affect the employment nature (Abbas et al., 2018; Rahayu, 2021; Rajiani & Ismail, 2019). The expectations of lecturers are changing, which considerably influences the employee satisfaction. Accordingly, a series of dissatisfaction is happening as lecturers like other Indonesian public sector apparatus prefer to work conventionally instead of operating technology aided and information-based

gadgets and online methods (Budi et al., 2021; Riana et al., 2020). Although the unified theory of acceptance and use of technology (UTAUT) model is validated within the Indonesian public university sector, the adoption of elearning technology is not that simple due to the rigid culture. This is the reason why although the IT enormous investment has been conducted for more than three decades in Indonesia, the performance of the projects remains sluggish. To sum up, although partially implemented, at the strategic level e-learning is still not considered as innovation yet, instead it proves irritation and annoyance in the Indonesian universities.

## V. CONCLUSION, IMPLICATIONS AND LIMITATION

The enormous dissimilarity, environmentally, economically, and technologically, in the market environment and management mechanisms between developed countries and Indonesia, produce difference research results on e-learning. The study revealed that, within Indonesians' public universities, nobody in a lower level dared to make decision openly without referring to the decisions of their respective superiors. The lecturers in these universities like to embrace a cautious demeanor which could best be portrayed as hanging tight for the letter containing a choice made by deans or a formal go or no-go choices made by rectors in open gatherings. Consequently, the act of accepting innovations like e-learning must be connected to the interests of top executives because of their ability to affect the participation. Therefore, if university leaders want to achieve their strategic objectives, the mere introduction of e-learning is not sufficient; rather, they need to take a holistic approach and increase the efficacy of the e-learning system by focusing on the quality of the services offered.

This study was confined to the selected universities of Indonesia, which was a limitation of this study and also raised the issues of generalizability and predictive cost of its outcomes for different universities. Extending this study to different regions of the country is additionally viable future lookup path that would ly allow comparisons of effects with the cutting-edge findings. Furthermore, the facts had been amassed the usage of the questionnaire, from a single supply (faculty members) at one factor in time. To manipulate this possible problem, future research ought to gather facts from a couple of sources or at special factors in time or combine the order of the questions to use special scale types. Moreover, future research should utilize a longitudinal graph to supply extra strong causal relationships.

**REREFENCES**

Abbas, E. W., Hadi, S., & Rajiani, I. (2018). The prospective innovator in public university by scrutinizing particular personality traits. Polish Journal of Management Studies, 18(1), 9–19. https://doi.org/10.17512/pjms.2018.18.1.01

Agarwal, S., & Lenka, U. (2018). Managing organization effectiveness through e-human resource management tool-e-learning: Indian cases a qualitative approach. PEOPLE: International Journal of Social Sciences, 4(1), 298-312. https://doi.org/10.20319/pijss.2018.41.298312

Al-Debei, M. M., Abdeljaber, O., Ab Yajid, M. S., Khatibi, A., Al-masaeed, S., & Tham, J. (2021). The Role of Service Quality and Online Trust in Maintaining Clients for Malaysian Online Enterpreises. International Journal of eBusiness and eGovernment Studies, 13(2), 149-167. https://sobiad.info/index.php/ijebeg/article/view/847/93

Al-Sharah, N., Dudeen, H., Ab Yajid, M. S., Khatibi, A., & Ariffin, I. (2021). The learning of vocabulary and the usage of portmanteaus by Jordanian EFL students. Eurasian Journal of Applied Linguistics, 7(2), 147-161. https://ejal.info/menuscript/index.php/ejal/article/view/113/15

Alavi, M., Visentin, D. C., Thapa, D. K., Hunt, G. E., Watson, R., & Cleary, M. L. (2020). Chi-square for model fit in confirmatory factor analysis. https://doi.org/10.1111/jan.14399

Alnoor, A. M. R., Al-Abrrow, H., Abdullah, H., & Abbas, S. (2020). The impact of self-efficacy on employees' ability to accept new technology in an Iraqi university. Global Business and Organizational Excellence, 39(2), 41-50. https://doi.org/10.1002/joe.21984

Alsahlawi, A. M. (2021). The Role of Hedging and Derivatives Techniques and Fintech Adoption on Financial Risk Management in Saudi Banks. Cuadernos de Economía, 44(126), 10-22. https://cude.es/submit-amanuscript/index.php/CUDE/article/view/197/187

Arfi, W. B., Nasr, I. B., Kondrateva, G., & Hikkerova, L. (2021). The role of trust in intention to use the IoT in eHealth: Application of the modified UTAUT in a consumer context. Technological Forecasting and Social Change, 167, 120688. https://doi.org/10.1016/j.techfore.2021.120688

Baydar, F., & CETIN, M. (2021). The Model of Relationships between Intellectual Capital, Learning Organizations, and Innovation-Oriented Organizational Structures in Educational Organizations. Eurasian Journal of Educational Research (EJER)(94), 265-294. https://ejer.com.tr/wpcontent/uploads/2021/08/ejer.2021.94.12.pdf

Beinicke, A., & Kyndt, E. (2020). Evidence-based actions for maximising training effectiveness in corporate Elearning and classroom training. Studies in Continuing Education, 42(2), 256-276. https://doi.org/10.1080/0158037X.2019.1608940

Berkowsky, R. W., Sharit, J., & Czaja, S. J. (2017). Factors predicting decisions about technology adoption among older adults. Innovation in aging, 1(3), igy002. https://doi.org/10.1093/geroni/igy002

Bissola, R., & Imperatori, B. (2013). Facing e-HRM: the consequences on employee attitude towards the organisation and the HR department in Italian SMEs. European Journal of International Management, 7(4), 450-468. https://doi.org/10.1504/EJIM.2013.055282

Bonett, D. G., & Wright, T. A. (2015). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. Journal of organizational behavior, 36(1), 3-15. https://doi.org/10.1002/job.1960

Budi, N. F. A., Adnan, H. R., Firmansyah, F., Hidayanto, A. N., Kurnia, S., & Purwandari, B. (2021). Why do people want to use location-based application for emergency situations? The extension of UTAUT perspectives. Technology in Society, 65, 101480. https://doi.org/10.1016/j.techsoc.2020.101480

Fregnan, E., Ivaldi, S., & Scaratti, G. (2020). Hrm 4.0 and new managerial competences profile: the comau case. Frontiers in psychology, 3113. https://doi.org/10.3389/fpsyg.2020.578251

Garzón-Artacho, E., Sola-Martínez, T., Romero-Rodríguez, J.-M., & Gómez-García, G. (2021). Teachers'

perceptions of digital competence at the lifelong learning stage. Heliyon, 7(7), e07513. https://doi.org/10.1016/j.heliyon.2021.e07513

Hair Jr, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. Journal of Business Research, 109, 101-110. https://doi.org/10.1016/j.jbusres.2019.11.069

Hamel, T. (2021). La technologie et le ‘style de guerre américain. Res Militaris, 11(1), 1-32. https://resmilitaris.net/index.php/2021/01/01/id1032512/

Hamsal, M., Ichsan, M., Utomo, A. R., Fahira, A. A., & Wetik, R. E. (2021). The Relationship Analysis Between Knowledge & Skills, Organizational Drivers, and Perceived Success in Implementation of Agile Project

Management: Case Study of PT XYZ. International Journal of Operations and Quantitative Management, 27(2), 111-126. https://doi.org/10.46970/2021.27.2.2

Harlie, M., Rajiani, I., & Abbas, E. W. (2019). Managing information systems by integrating information systems success model and the unified theory of acceptance and usage of technology. Polish Journal of Management Studies, 20. https://doi.org/10.17512/pjms.2019.20.1.17

Hu, L. t., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural equation modeling: a multidisciplinary journal, 6(1), 1-55. https://doi.org/10.1080/10705519909540118

Ibrahim, H. (2021). Study of The Interactions of Human Resource Performance and Electronic Human Resource Management in Small Companies. Journal of Humanities Insights, 5(01), 24-32.

Jordaan, H., & Coetzee, J. (2021). Acces to Finance Perceived as an Obstable and The Characteristics of The SMME And Its Owner: Evidence from Free State Gpoldfields-South Africa. International Journal of Economics and Finance Studies, 13(1), 373- 404. https://sobiad.info/index.php/ijefs/article/view/677/66

Julia, K., & Marco, K. (2021). Educational scalability in MOOCs: Analysing instructional designs to find best practices. Computers & Education, 161, 104054. https://doi.org/10.1016/j.compedu.2020.104054

Kaizer, B. M., Silva, C. E. S., de Pavia, A. P., & Zerbini, T. (2020). E-learning training in work corporations: areview on instructional planning. European Journal of Training and Development, 44(6/7), 615–636. https://doi.org/10.1108/EJTD-08-2019-0149

Kapo, A., Mujkic, A., Turulja, L., & Kovacevic, J. (2020). Continuous e-learning at the workplace: the passport for the future of knowledge. Information Technology & People, 34(5), 1462–1489. https://doi.org/10.1108/ITP-04-2020-0223

Kokoç, M., & Altun, A. (2021). Effects of learner interaction with learning dashboards on academic performance in an e-learning environment. Behaviour & Information Technology, 40(2), 161-175. https://doi.org/10.1080/0144929X.2019.1680731

Kot, S., & Rajiani, I. (2020). Testing and identifying variable dependency through the Fisher exact test in central Europe enterprises. Ekonomicko-manazerske spektrum, 14(1), 10-18. https://doi.org/10.26552/ems.2020.1.10-18

Kuechler, W., & Stedham, Y. (2018). Management education and transformational learning: The integration of mindfulness in an MBA course. Journal of Management Education, 42(1), 8-33. https://doi.org/10.1177/1052562917727797

Lepak, D. P., Bartol, K. M., & Erhardt, N. L. (2005). A contingency framework for the delivery of HR practices. Human resource management review, 15(2), 139-159. https://doi.org/10.1016/j.hrmr.2005.06.001

Lipinska, E. J. (2021). Koncepcja ekozarzadzania miastami w kontekscie zrównowazonego rozwoju iodpowiedzialnosci spolecznej. socialspacejournal.eu, 21(1), 117-135. https://socialspacejournal.eu/wpcontent/uploads/2021/12/Social-Space-Journal-1202121.pdf

Martini, M., Cavenago, D., & Marafioti, E. (2020). Exploring types, drivers and outcomes of social e-HRM. Employee Relations: The International Journal. https://doi.org/10.1108/ER-10-2019-0404

Netanda, R. S., Mamabolo, J., & Themane, M. (2019). Do or die: student support interventions for the survival of distance education institutions in a competitive higher education system. Studies in Higher Education, 44(2), 397-414. https://doi.org/10.1080/03075079.2017.1378632

Pretorius, R. W., Anderson, R., Khotoo, A., & Pienaar, R. (2019). Creating a context for campus sustainability through teaching and learning: The case of open, distance and e-learning. International Journal of Sustainability in Higher Education. https://doi.org/10.1108/IJSHE-02-2019-0066

Rafiee, M., & Abbasian-Naghneh, S. (2021). E-learning: development of a model to assess the acceptance and readiness of technology among language learners. Computer Assisted Language Learning, 34(5-6), 730-750. https://doi.org/10.1080/09588221.2019.1640255

Rahayu, S. (2021). Exploring e-learning platforms used by students in Indonesia during the Covid-19 pandemic. In Educational Innovation in Society 5.0 Era: Challenges and Opportunities (pp. 74-79). Routledge. https://doi.org/10.1201/9781003206019-15

Rajiani, I., & Ismail, N. (2019). Management innovation in balancing technology innovation to harness universities performance in the era of community 4.0. Polish Journal of Management Studies, 19. https://doi.org/10.17512/pjms.2019.19.1.24

Riana, I. G., Suparna, G., Suwandana, I. G. M., Kot, S., & Rajiani, I. (2020). Human resource management in promoting innovation and organizational performance. Problems and Perspectives in Management, 18(1), 107. https://doi.org/10.21511/ppm.18(1).2020.10

Sarbaini, S., Jumadi, J., Abbas, E. W., & Rajiani, I. (2019). Managing e-learning in public universities by investigating the role of culture. Polish Journal of Management Studies, 20(1), 394–404. https://doi.org/10.17512/pjms.2019.20.1.34

Sayeed, L., & Onetti, A. (2018). The relationship between organizational resources and Green IT/S The relationship between organizational resources and Green IT/S adoption: A RBV approach adoption: A RBV apprach. Journal of International Technology and Information Management, 27(2), 43–72.

Shin, H.-Y. (2019). An Exploratory Study on the e-learning Motives and Intent of e-learning Learners. Journal of the Korea Convergence Society, 10(7), 225-233.

Szablewicz, M. (2020). From the media fast to digital detox: Examining dominant discourses about technology use. Communication teacher, 34(3), 180-184. https://doi.org/10.1080/17404622.2019.1676913

Venkatesh, V. (2021). Adoption and use of AI tools: a research agenda grounded in UTAUT. Annals of Operations Research, 1-12. https://doi.org/10.1007/s10479-020-03918-9

Wang, X.-Y., Li, G., Malik, S., & Anwar, A. (2021). Impact of COVID-19 on achieving the goal of sustainable development: E-learning and educational productivity. Economic Research-Ekonomska Istraživanja, 1- 17. https://doi.org/10.1080/1331677X.2021.1952090

Yamoah, F. (2020). Understanding utility essentials of e-learning management systems in higher education: a multi-generational cohort perspective. Open Learning: The Journal of Open, Distance and e-Learning.

Yang, L., Xiaoxu, Z., Aziz, N., & Jun, H. (2021). Do Peer Effects Influence the Intention of Students to Participate in Entrepreneurship and Innovation Activities? Evidence from Nanjing Agricultural University, China. Educational Sciences: Theory & Practice, 21(2), 85-100. https://jestp.com/index.php/estp/article/view/1432/795

Yuen, K. F., Cai, L., Qi, G., & Wang, X. (2021). Factors influencing autonomous vehicle adoption: an application of the technology acceptance model and innovation diffusion theory. Technology Analysis & Strategic Management, 33(5), 505-519. https://doi.org/10.1080/09537325.2020.1826423

Zalazar-Jaime, M. F., Moretti, L. S., García-Batista, Z. E., & Medrano, L. A. (2021). Evaluation of an academic satisfaction model in E-learning education contexts. Interactive Learning Environments, 1-11. https://doi.org/10.1080/10494820.2021.1979047

# Sumber Artikel


1. Ahmad Suriansyah, Sutarto Hadi, Aminuddin Prahatama Putra Putera, Aslamiah. Education in Disruption 4.0 Era Development of Work Culture in Elementary School at Banjarmasin South Kalimantan Indonesia. *Hamdard Islamicus*, Vol. 43 No. S-2 (2020), 512- 528. http://www.hamdardislamicus.com.pk
2. Muhammad Rizki, Sutarto Hadi, Sulaiman. (2020). Parents' Considerations Factors in Choosing Elementary School. *Jouurnal of K6 Education and Management*, 2(4), 312-322. http://j-k6em.org/index.php/jkemorg/article/view/366
3. Rachmadinoor, Sutarto Hadi, Suhaimi. Role of School Heads in Improving Quality of Education (Study of Multi Site SDN SN Pasar Lama 1 and SDN Sungai Miai 10 Banjarmasin). *International Journal of Scientific Development and Research* (IJSDR), Volume 3, Issue 12. www.ijsdr.org 6.
4. Susilawati, Erny Wahdini, Sutarto Hadi. Implementation of Early Childhood Character Education in the 2013 Curriculum. *Journal of K6, Education, and Management*, 2019, Vol. 2, No. 3, 193 – 203. http://dx.doi.org/10.11594/jk6em.02.03.03.
5. Asrul Hidayat, Sutarto Hadi, Darmiyati. Development of Cognitive Aspects of Children in Matching Numbers with Number Symbols using a Combination of Demonstration, Make a Match Models Assisted by Audio Visual Media. *Journal of K6, Education, and Management (J-K6EM) Vol. 2, No. 2, 2019,* pp. 133-138. ISSN 2580-2135.
6. Ersis Warmansyah Abbas, Sutarto Hadi, Ismi Rajiani. "Guru Sekumpul" as The Prophetical Model of Entreneurship form Islamic Perspective. *Proceedings of ADVED 2019- 5th International Conference on Advances in Education and Social Sciences* 21-23 October 2019- Istanbul, Turkey
7. Eko Prayitno, Sutarto Hadi, Muhammad Saleh. The Bilingual School Program Management. *Journal of K6, Education, and Management* (J-K6EM) Vol. 2, No. 1, 2019, pp. 64-70. ISSN 2580-2135.

8. Muhammad Ali Permadi, Sutarto Hadi, M. Mahrita. The Relationship of Work Motivation and The Use of Communication and Information Technology (TIK) with Service at Islamic School (MAN) in Banjarmasin, Indonesia. *European Journal of Alternative Education Studies* (ISSN 2501-5915), Vol 4, No 1 (2019). https://oapub.org/edu/index.php/ejae/article/view/2315.
9. Noorhapizah, Siti Aisyah, Sutarto Hadi. Analysis of Science and Mathematics Development of Early Childhood. *Journal of K6, Education, and Management* (j-K6EM). ISSN: 2580-2135.
10. Karim, Agni Danaryanti, Sutarto Hadi. Developing a Learning Decimal Counting Operation. *Proceedings of the 1st International Conference on Creativity, Innovation and Technology in Education* (IC-CITE 2018). https://www.atlantis-press.com/proceedings/iccite-18/55909568.
11. Baharuddin, Sutarto Hadi, Abdul Hamid, Ariffin Abdul Mutalib, Juhriyansyah Dalle. Dilemma Between Applying Coherent Principle and Signaling Principles In Interactive Learning Media. *The Open Psychology Journal*. *https://openpsychologyjournal*.com/VOLUME/11/PAGE/235/.
12. Derlina, Juhriyansyah Dalle, Sutarto Hadi, Ariffin Abdul Mutalib, Candra Sumantri (2018). Signaling Principles in Interactive Learning Media Through Expert's Walkthrough. *Turkish Online Journal of Distance Education-TOJDE* October 2018 ISSN 1302-6488 Volume: 19 Number: 4 Article 9.
13. Ade Budhi Rahayu, Sutarto Hadi, Maya Istyadji, Muhammad Zaini, Arif Sholahuddin, F. Fahmi. Development of Guide Inquiry Based Learning Devices to Improve Student Learning Outcomes in Science Materials in Middle School. *European Journal of Alternative Education Studies* (ISSN 2501-5915), Vol 3, No 2 (2018). https://oapub.org/edu/index.php/ejae/article/view/2149.
14. Ersis Warmansyah Abbas, Sutarto Hadi, Ismi Rajiani. The Prospective Innovator in Public University by Scrutinizing Particular Personality Traits. *Polish Journal of Management Studies* 2018; 18 (1): 9-19. https://pjms.zim.pcz.pl/resources/html/article/details?id=183832.
15. Mohammad Zaenal Anis, Sutarto Hadi, Ismi Rajiani, Ersis Warmansyah Abbas. The Managerial Effects of Leaddership, Knowledge Sharing and Innovation in Higher Education. *Polish Journal of Management Studies* Vol.23 No.1, 2021. https://pjms.zim.pcz.pl/resources/html/article/details?id=217289.

16. Qomariyatus Sholihah, Aprizal Satria Hanafi, Wanti Wanti, Ahmad Alim Bachri, Sutarto Hadi. Analisis Sif Kerja, Masa Kerja, dan Budaya Keselamatan dan Kesehatan Kerja dengan Fungsi Paru Pekerja Tambang Batu Bara. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*, Vol. 10 No. 1 Agustus 2015. http:// journal.fkm.ui.ac.id/kesmas/article/view/812.
17. Sutarto Hadi. Number Sense Berpikir Fleksibel dan Intuisi Tentang Bilangan. *Math Didactic: Jurnal Pendidikan Matematika*, Vol 1 No 1 (2015). https://jurnal.stkipbjm.ac.id/index.php/math/article/view/89.
18. Sutarto Hadi, Maidatina Umi Kasum. Pemahaman Konsep Matematika Siswa SMP Melalui Penerapan Model Pembelajaran Kooperatif Tipe Memeriksa Berpasangan (Pair Checks). *EDUU-MAT Jurnal Pendidikan Matematika*, Volume 3, Nomor 1, April 2015. https://ppjp.ulm.ac.id/journal/index.php/edumat/article/view/630/538.
19. Hidayah Ansori, Sutarto Hadi, Rizki Amalia, Maulida Fitri. Bimbingan Pembuatan Proposal PTK Bagi Guru Peserta MGMP Matematika Kota Banjarmasin. *Bubungan Tinggi: Jurnal Pengabdian Masyarakat*, Vol.2, No 2 (2020). https://ppjp.ulm.ac.id/journals/index.php/btj/article/view/1791.
20. Gilang Zulfairanatama, Sutarto Hadi. Kecerdasan Logika-Matematika Berdasarkan Multiple Intelligences Terhadap Kemampuan Matematika Siswa SMP di Banjarmasin. *EDUU-MAT Jurnal Pendidikan Matematika*, Vol 1, No 1 (2013). https://ppjp.ulm.ac.id/journal/index.php/edumat/article/view/549.
21. Sutarto Hadi, Radiyatul Radiyatul. Metode Pemecahan Masalah Menurut Polya untuk Mengembangkan Kemampuan Siswa dalam Pemecahan Masalah Matematis di Sekolah Menengah Pertama. *EDUU-MAT Jurnal Pendidikan Matematika*, Vol 2, No 1 (2014). https://ppjp.ulm.ac.id/journal/index.php/edumat/article/view/603.
22. Agung Nugroho, Dessy Maulidya, Maharani, Agung Cahyo Legowoa, SutartoHadi, Febriani Purba. Enhanced mechanical and physical properties of starch foam from the combination of water hyacinth fiber (Eichhornia crassipes) and polyvinyl alcohol. *Industrial Crops and Products*, Volume 183, 1 September 2022, 114936. https://www.sciencedirect.com/science/article/abs/pii/S0926669022004198.

23. Muthia Elma, Anna Sumardi, Adhe Paramita, Aulia Rahma, Aptar Eka Lestari, Dede Heri Yuli Yanto, Sutarto Hadi, Zaini Lambri Assyaifi, Sunardi, and Yanuardi Raharjo. Physicochemical Properties of Mesoporous Organo-Silica Xerogels Fabricated through Organo Catalyst. *Membranes* 2021, 11(8), 607. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8401293/.

24. Juhriyansyah Dalle, Sutarto Hadi, Baharuddi, Nurlaila Hayati. The Development of Interactive Multimedia Learning Pyramid and Prism for Junior High School Using Macromedia Authorware. *TOJET: The Turkish Online Journal of Educational Technology* – November 2017, Special Issue for IETC 2017. http://eprints.ulm.ac.id/7750/1/1.c.5-Artikel% 20Jurnal% 20Internasional.pdf.

25. Herry Porda Nugroho Putro, Sutarto Hadi, Ismi Rajiani, Ersis Warmansyah Abbas, Mutiani. Adoption of e-Learning in Indonesian Higher Education: Innovation or Irritation? *Educational Sciences: Theory and Practice*, Vol. 22 No. 1 (2022). https://jestp.com/index.php/estp/article/view/1550.

# Penulis

**Sutarto Hadi**, Guru Besar Pendidikan Matematika Universitas Lambung Mangkurat (ULM) Banjarmasin, lahir di Banjarmasin, 31 Maret 1966. Anak Raden Soetarman (alm) dan Siti Hadidjah (alm). Menyelesaikan pendidikan dasar dan menengah di Banjarmasin, S1 Pendidikan Matematika FKIP ULM dan pendidikan S2 Matematika Pascasarjana UGM (1996). Memperoleh gelar MSc bidang *Educational and Training Systems Design* dari University of Twente, Belanda (1999) dan Doktor (Dr) bidang Pendidikan Matematika (2002) dengan disertasi *Effective Teacher Professional Development for the Implementation of Realistic Mathematics Education in Indonesia*.

Sutarto Hadi menjadi Mahasiswa Teladan (1988) dan Mahasiswa Berprestasi FKIP ULM (1989), guru di beberapa sekolah di Banjarmasin, dosen di Prodi Pendidikan Matematika FKIP ULM (1991) dan Guru Besar (Profesor) dalam bidang Pendidikan Matematika (2007). Menjadi Pembantu Rektor IV Bidang Perencanaan dan Kerjasama ULM 2010-2014 dan menjadi Wakil Ketua Forum Rektor Indonesia (FRI) 2018 dan Rektor ULM dua periode, 2014-2018 dan 2018-2022.

Sutarto Hadi mengikuti pelatihan dan workshop di dalam dan di luar negeri, antara lain: *Pelatihan Analisis Multivariat di Lembaga Demografi*, Fakultas Ekonomi UI (1997), *Research Workshop on Systems and Control*, ITS Surabaya (1998), *Research Workshop on Mathematics Education*, ITB (1998), Penataran Penulisan Buku Ajar Perguruan Tinggi, Bandung (2006), *Counterpart Training on Lesson Study–JICA*, Jepang (2010), dan Program *Academic Recharging* (PAR) Dikti di University of Colorado, Boulder, Amerika Serikat (2010).

Aktivitas profesional di dalam dan di luar negeri sebagai tanggung jawab Tridharma Perguruan Tinggi, antara lain: Konsultan Pengembangan Mutu Pendidikan MIPA Kabupaten Kotabaru (2003), Anggota IndoMS (The Indonesian Mathematical Society). Tim Korektor Jurnal Kependidikan dan Kebudayaan Widya Karya (2004–sekarang), Indonesia Representative for ICMI (International Commission on Mathematical Instruction) (2004 – 2012), Konsultan Dinas Pendidikan Kab. HSS (2004–2010), Lead Facilitator School Development and Investment Plan (SDIP) Rintisan Sekolah Bertaraf Internasional Provinsi Kalimantan Selatan (2005), Pengurus Daerah KAGAMA Kalsel (2005–sekarang), Pengurus Ikatan Alumni (IKA) ULM (2005–sekarang), Anggota Dewan Redaksi Majalah Ilmiah Kalimantan Scientia (2005 – 2010), Anggota Dewan Riset Daerah (DRD) Provinsi Kalsel (2006–sekarang), Panitia Pengarah Konferensi Nasional Matematika XIII (KNM XIII) dan Kongres Himpunan Matematika Indonesia di UNNES, Semarang (2006), Anggota Tim PMRI, Kerjasama Dikti dan Pemerintah Belanda (APS dan Freudenthal Institute) (2006–sekarang), Pengurus Pusat IndoMS (The Indonesian Mathematical Society) Periode (2004–2006 dan 2006–2008), Fasilitator Daerah Sekolah Nasional Bertaraf Internasional, Direktorat Pembinaan SMA, Depdiknas, Jakarta (2006–2008), Pemimpin Redaksi Majalah PMRI (2005–2010), Panitia Pengarah Konferensi Nasional Matematika XIV (KNM XIV) dan Kongres Himpunan Matematika Indonesia di UNSRI, Palembang (2008), Anggota International Advisory Committee CoSMEd 2007 di SEAMEO RECSAM, Penang, Malaysia (2007), Anggota Editorial Board Journal of Science and Mathematics Education in Southeast Asia, SEAMEO RECSAM, Penang, Malaysia, Ketua Himpunan Matematika Indonesia (IndoMS) Kalimantan Selatan (2007–2009), Anggota International Advisory Committee CoSMEd 2009 di SEAMEO RECSAM, Penang, Malaysia, Panitia Pengarah Konferensi Nasional Pendidikan Matematika III (KNPM III), di UNIMED Medan (2009), Fellow ISDDE (International Society for Design and Development in Education) Advisor Pengembangan SBI Dinas Pendidikan Provinsi Kalimantan Selatan (2010–sekarang), Anggota International Advisory Committee CoSMEd 2011 di SEAMEO RECSAM, Penang, Malaysia (2011), Regular Lecturer ICME-12 Seoul, 6 – 15 Juli 2012: "Mathematics education reform movement in Indonesia" (2012), Anggota International Advisory Committee CoSMEd 2013 di SEAMEO RECSAM, Penang, Malaysia, Anggota Komite Akademik 27th International Congress on School Effectiveness and Improvement (ICSEI-27), 2014, Yogyakarta.

Sutarto aktif memberikan workshop dan pelatihan kepada guru-guru seperti di SEAMEO QITEP in Mathematics di Yogyakarta, dan di SEAMEO RECSAM di Malaysia. MMenulis opini di media massa dan anggota Dewan Riset Daerah (DRD) dan anggota Badan Pertimbangan Pendidikan Provinsi Kalimantan Selatan. Aktif dalam Himpunan Matematika Indonesia atau IndoMS (The Indonesian Mathematical Society), menjadi perwakilan Indonesia di ICMI (International Commission on Mathematical Instruction), 2004 hingga 2012. Aktif terlibat dalam pengembangan dan implementasi Pendidikan Matematika Realistik Indonesia (PMRI), anggota Panitia Pengarah pada penyelenggaraan Konferensi Nasional Matematika (KNM) XIII, 2006 di Semarang, dan KNM XIV, 2008 di Palembang. Anggota Panitia Pengarah Konferensi Nasional Pendidikan Matematika (KNPM) III, 2009 di Medan. Sejak 2007 menjadi anggota Panitia Pengarah Internasional (International Advisory Committee) pada Conference on Science and Mathematics Education (CoSMEd).

Ia juga dipercaya sebagai penyelia (reviewer) pada beberapa jurnal pendidikan di dalam dan luar negeri, seperti Edumat (terbitan P4TK Matematika, Yogyakarta) dan Journal of Science and Mathematics Education in Southeast Asia (terbitan SEAMEO RECSAM, Penang, Malaysia).

Menjadi pembicara dalam berbagai forum ilmiah nasional dan internasional, anatar lain : Konferensi Nasional Matematika (KNM) 2004 di Bali. Peran Sutarto dalam pendidikan matematika diakui komunitas internasional. Pada International Congress on Mathematical Education ke-12 (ICME-12) tahun 2012 di Seoul diminta memberi kuliah (regular lecture) dengan makalah berjudul Mathematics Education Reform Movement in Indonesia. Sebelumnya, pada EARCOME 4 (East Asia Regional Conference on Mathematics Education), 2007 di Penang, Malaysia ia membawakan makalah, Adapting European Curriculum Materials for Indonesian Schools: A Design of Learning Trajectory of Fraction for Elementary Education Mathematics.

Sutarto juga aktif di The International Society for Design and Development in Education (ISDDE). Menyampaikan makalah di konferensi ISDDE di Oxford (2006) dan Cairn (2008). Karena peran dan kontribusinya dalam bidang tersebut, ISDDE mengangkat Sutarto Hadi sebagai Fellow of the Society.

Menjadi pembicara di International Congress on School Effectiveness and Improvement (ICSEI) ke-24 tahun 2010 di Kuala Lumpur dan diluncurkannya buku “A decade of PMRI in Indonesia”, Sutarto menyumbang 3 bab. Pada Konferensi ICSEI ke-25, 2011 di Siprus ia membawakan makalah

berjudul The impact of workshop to teachers' competencies in innovation implementation. Pada Konferensi ICSEI ke-27, 2014 di Yogyakarta, Sutarto menjadi pembicara pada dua sesi. Pertama bersama Prof Robert Sembiring menyampaikan Current Development of PMRI Movement, kedua menyampaikan makalah berjudul Developing Students' Mathematical Literacy: PMRI Schools Revisited.

Pada saat menjabat Pembantu Rektor IV Bidang Perencanaan dan Kerjasama Sutarto ditunjuk oleh Rektor Prof. M. Ruslan menjadi Direktur Eksekutif Proyek IDB 7in1 dengan tugas menyusun proposal. Alhamdulillah proyek tersebut berhasil didanai oleh IDB (Islamic Development Bank), ULM mendapat dana paling besar yaitu kurang lebih Rp 500 miliyar. Saat ini sedang berlangsung pembangunan 12 gedung baru ULM yang dibiayai dari IDB.

Sebagai rektor Sutarto Hadi aktif dalam organisasi para rektor seperti di Majelis Rektor Perguruan Tinggi Negeri Indonesia (MRPTNI) dan di Forum Rektor Indonesia (FRI), yaitu menjadi Anggota Dewan Pertimbangan FRI tahun 2016 dan 2017. Pada bulan Januari 2017, pada Konvensi Nasional dan Pertemuan Tahunan Forum Rektor Indonesia (FRI), Sutarto Hadi terpilih secara aklamasi sebagai Wakil Ketua FRI untuk masa bakti tahun 2018.

Sebagai dosen dan akademisi di tengah-tengah kesibukan sebagai rektor, Sutarto Hadi tetap aktif meneliti, menulis dan hadir sebagai pembicara di seminar dan konferensi baik nasional maupun internasional. Pada bulan Juli 2016, Sutarto Hadi menjadi pembicara di ICME-13 (13th International Congress on Mathematics Education) di Hamburg, Jerman. Sebelumnya pada ICME-12 di Seoul, Korea Selatan, Sutarto Hadi diundang menjadi pembicara Regular Lecture membawakan makalah berjudul Mathematics Education Reform Movement in Indonesia. Tulisan tersebut dipublikasikan dalam buku Selected Regular Lectures from the 12th International Congress on Mathematics Education oleh Penerbit Springer (2015).

Sutarto aktif menulis, diantara karyanya :

Sutarto Hadi (2000). Menjamin Mutu Pendidikan di Era Otonomi Daerah. Orasi Ilmiah pada Wisuda ke-9 dan Dies Natalis ke-14 STKIP-PGRI Banjarmasin.

Sutarto Hadi (2001). Memperkenalkan RME kepada Guru SLTP di Yogyakarta. Makalah disampaikan pada Seminar Nasional RME di Universitas Negeri Surabaya

Sutarto Hadi (2001). PMRI: Beberapa Catatan Sebelum Melangkah Lebih Jauh. Makalah disampaikan pada Seminar Nasional RME di Universitas Sanata Dharma, Yogyakarta

Sutarto Hadi (2002). From American Context to Indonesian: Does it work? Paper presented at the 1st Seminar on Applied Mathematics, Faculty of Mathematical Science, University of Twente, the Netherlands).

Sutarto Hadi, Tj. Plomp, dan Suryanto (2002). Introducing RME to Junior High School Mathematics Teachers in Indonesia. Proc. 2nd International Conference on the Teaching of Mathematics (ICTM2), John Wiley & Sons Inc.

Sutarto Hadi (2003). Tinjauan Metodologi IndoMath Study. Jurnal Kependidikan, Nomor I, Tahun XXXIII, Mei 2003

Sutarto Hadi dan A. Fauzan (2003). Mengapa PMRI? Buletin PMRI, Edisi I, Juni 2003

Sutarto Hadi (2003). Membimbing Siswa Memahami Konsep Peluang Melalui Soal-soal Kontekstual. Jurnal Kependidikan dan Kebudayaan Vidya Karya, Tahun XXI, Nomor 3

Soedjadi dan Sutarto Hadi (2004). PMRI dan KBK dalam Era Otonomi Pendidikan.Buletin PMRI, Edisi III, Januari 2004

Sutarto Hadi (2004). Kerangka Didaktik PMRI. Buletin PMRI, Edisi IV, April 2004

Sutarto Hadi (2004). Mempersiapkan Guru Mengajar Matematika Secara Efektif: Sebuah Pengalaman dari Proyek PMRI. Prosiding Konferensi Nasional Matematika XII Bali, 23 -27 Juli, 2004

Sutarto Hadi (2004). Didactical Framework of PMRI. Paper presented at Conference on Recent Progress in Mathematics Education – CRPME 2004, ITB, 6 – 8 September 2004

Sutarto Hadi (2004). Kurikulum Berbasis Kompetensi dan Paradigma Baru Pembelajaran Matematika. Makalah disajikan pada Workshop KBK dan Paradigma Baru Pembelajaran Matematika, Yayasan Bina Banua Banjarmasin, 2 Oktober 2004

Sutarto Hadi (2004). Alat Peraga Murah dalam PMRI. Buletin PMRI, Edisi V, Oktober 2004

*Penulis*

Sutarto Hadi (2005). Pendahuluan ke Pemahaman Pecahan. Buletin PMRI, Edisi VI, Februari 2005.

Sutarto Hadi (2005). Memahami Pecahan dengan Pendekatan Realistik. Makalah disampaikan pada Konferensi Nasional Pendidikan Matematika Pertama (KNPM-1), SBI Madania, Bogor, 9 – 11 April 2005

Sutarto Hadi (2005). The Framework for the Implementation of Realistic Mathematics Education in Indonesia. Proc. Int. Conf. on Applied Mathematics (ICAM05), Bandung: ITB

Sutarto Hadi (2006). Learning Trajectory of Fraction in Elementary Education Mathematics. Proc. of the 30th Conference of the International Group for the Psychology of Mathematics Education (PME30), Prague: Charles University

Sutarto Hadi (2006). Pengembangan Materi Pembelajaran Pecahan Berdasarkan Pendekatan Realistik. Jurnal Kependidikan dan Kebudayaan Vidya Karya, Tahun XXIV, No. 1, April 2006

Sutarto Hadi (2006). Matematika Versi Kartun Calvin and Hobbes. Majalah PMRI, Edisi VIII, April 2006

Sutarto Hadi (2006). Alur Pembelajaran Pecahan di Sekolah Dasar. Jurnal Pembelajaran, Vol. 29, Nomor 01, April 2006

Sutarto Hadi (2006). PMRI, Benih Pembelajaran Matematika yang Bermutu. Majalah PMRI, Vol. IV, No. 3, Oktober 2006

Sutarto Hadi (2006). Analisis Hubungan Input Sekolah dengan Hasil Belajar Siswa di Kabupaten Hulu Sungai Selatan. Jurnal Kependidikan dan Kebudayaan Vidya Karya, Jilid 24, No. 2, Oktober 2006

Sutarto Hadi dan Wiraatmaja I. Gt. Ng. (2007). Teacher Professional Development through Schools Cluster Meeting. Paper Presented at the Second International Conference on Science and Mathematics Education (CoSMEd), Penang , Malaysia.

Sutarto Hadi (2007). Adapting European Curriculum Materials for Indonesian Schools: A Design of Learning Trajectory of Fraction for Elementary Education Mathematics. Proc. EARCOME4, Universiti Sains Malaysia, Penang, Malaysia

RK Sembiring, Sutarto Hadi, dan Maarten Dolk (2008). Reforming mathematics learning in Indonesian classroom through RME. ZDM: The International Journal on Mathematics Education, 40(6), 927-939.

Sutarto Hadi (2010). Preparing teacher for realistic mathematics education implementation; IndoMath Study, an educational design research. Lambert Academic Publishing.

Sutarto Hadi, Dolk, M. and Zonneveld, E. (2010). The role of key teachers in PMRI dissemination. In R. Sembiring, K. Hoogland & M. Dolk (Eds.), A decade of PMRI in Indonesia. Bandung, Utrecht: APS International.

Sutarto Hadi, Zulkardi, & Hoogland, K. (2010). Quality assurance in PMRI. In R. Sembiring, K. Hoogland & M. Dolk (Eds.), A decade of PMRI in Indonesia. Bandung, Utrecht: APS International.

Sembiring, R., Sutarto Hadi, Zulkardi, & Hoogland, K. (2010). The future of PMRI. In R. Sembiring, K. Hoogland & M. Dolk (Eds.), A decade of PMRI in Indonesia. Bandung, Utrecht: APS International.

Sutarto Hadi, Sumartono, Agni Danaryanti, and Bustanil Arifin (2011). The impact of workshop to teachers' competencies in innovation implementation. Proceeding 24th International Congress on School Effectiveness and Improvement (ICSEI-2011), January 04-07, Limassol-Cyprus.

Sutarto Hadi (2011). Pengembangan Sumber Daya Manusia yang Beraksara Matematika Melalui Pembelajaran Berbasis Masalah. Prosiding Seminar Nasional Kontribusi Matematika dalam Pengembangan Sumber Daya Manusia. Undiksha, Singaraja.

Sutarto Hadi (2011). Developing the nation character through realistic mathematics education. Paper presented at International Seminar and The Fourth National Conference on Mathematics Education. Universitas Negeri Yogyakarta.

Sutarto Hadi (2012). Mathematics Education Reform Movement in Indonesia. Regular Lecture, ICME-12 Seoul, South Korea.

*Penulis*

Sutarto Hadi (2014). Developing students' mathematical literacy: PMRI Schools Revisited. Paper presented at 27th International Congress on School Effectiveness and Improvement (ICSEI-27), Yogyakarta, 2 – 7 Januari 2014.

Sutarto Hadi

# MEMBUKUKAN ARTIKEL AKADEMIS

Buku *Membukukan Artikel Akademis* dapat dikatakan buku kagetan dan mengagetkan sebagai kumpulan tulisan (artikel) yang pada awalnya saya tidak tahu-menahu. Prof. Ersis Warmansyah Abbas, menyampaikan *dummy* buku tersebut kepada saya, tanpa pembicaraan terlebih dahulu akan membukukan tulisan-tulisan saya. Saya membaca isinya, terlepas dari kekurangan, bagus saja dibukukan. Apalagi, telah siap cetak.

Sebagai pribadi dan sebagai Rektor ULM, saya mengapresiasi "kecanduan" Prof. Ersis menulis, dari menulis hal-hal sederhana sampai menulis karya ilmiah. Ketika "kecanduan" tersebut ditularkan, baik melalui motivasi, sharing atau pelatihan, bahkan membukukan karya, tentu dengan maksud agar jangkauan "kecanduan menulis" menjangkiti sebanyak mungkin orang, terutama bagi insan akademis.

Seingat saya, gaya Prof. Ersis adalah, membicarakan hal-hal hulu, misalnya tentang membaca sampai keterampilan menulis yang kemudian bermuara kepada publikasi tulisan. Dalam pergaulan pribadi kami, kami banyak membicarakan pikiran para penulis hebat dunia, dari Socrates sampai Francis Fukiyama dalam pandangan ke kinian untuk menatap ke depan. Sekalipun disiplin saya pendidikan matematika, kami mendiskusikan muatan historis kehidupan manusia. Pada tataran tersebut, Prof. Ersis biasa masuk dengan kampanye : "Menulis sebagai aktivitas mengukir sejarah".

PROGRAM STUDI PENDIDIKAN IPS
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN
UNIVERSITAS LAMBUNG MANGKURAT
BANJARMASIN
2022

ISBN 978-623-99984-1-7