Students' self-regulation learning ability in learning algebraic forms in wetland context with the help of interactive multimedia

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Abstract. One branch of mathematics that is very useful in solving problems is algebra. In fact, junior high school students still face difficulties in learning algebra. This study aimed to develop interactive multimedia on algebraic-form material with a wetland context, to describe student self-regulation learning (SRL) abilities in learning algebraic forms using interactive multimedia with wetland contexts, and to analyse the relationship between SRL ability with student learning outcomes after learning on algebraic form material in wetland context with interactive multimedia assistance. This research was a development research using the ADDIE method. It was tested in small groups of seventh grade students of SMP Negeri 9 Banjarmasin. The data collection techniques used tests and questionnaires. The data analysis technique used descriptive statistics and simple linear regression. The results showed that interactive multimedia on wetland context-algebraic form material was valid and could be used in learning algebraic forms in seventh grade. The trial results showed that the average student learning outcomes were in the sufficient category and as many as 80.0 percent of students had reached the KKM determined by the school. Student's SRL ability was in the medium category, and there is no influence from SRL on student learning outcomes. The further research is needed in large groups to analyse how the influence of students' SRL skills on learning outcomes in interactive multimedia assisted learning.

1. Introduction

One branch of mathematics that is very useful as a tool for solving problems is algebra. In Indonesia formally algebra is only studied in seventh grade. Although algebra is very useful, in reality algebra is often seen as a difficult subject. There are still many students who have not been able to complete algebraic form operations properly because they have difficulty distinguishing between similar and dissimilar tribes, and do not yet understand the meaning of coefficients [1].

Learning success is influenced by various factors, both from within and from outside the student. According to [2] factors from within individual students include the ability of self-regulatory learning (SRL) in students, or the ability to manage their own learning. Effective learning can be achieved with SRL from students. The results of the study indicated that SRL had a positive effect on student academic achievement [3]. In the learning process, students who have SRL will build their learning goals. Then he will try to monitor, regulate, and control his cognition, motivation, and behavior to achieve the goals he has made.

Apart from internal factors, students' learning outcomes are also influenced by external factors, including the use of appropriate learning approaches and media. Mathematics is an abstract science, so it will be very helpful for students if in learning mathematics the teacher relates subject matter to the context of students' daily lives [4]. The results of the study [5] by connecting mathematics material with the daily context of students can develop students' creative thinking skills. South Kalimantan is an area that has a large wetland area. Thus, mathematics subject matter can be integrated with the context of wetlands in South Kalimantan.

Meanwhile, in accordance with the learning era 4.0, teachers are expected to be able to design student-centered learning activities and involve the use of information technology-based learning media. Interactive multimedia is an alternative learning media that teachers can use. Interactive multimedia is a medium that combines text, graphics, video, animation and sound, to convey a message and information, through electronic media such as computers and other electronic devices [6, 7]. Through interactive multimedia, students can learn with or without being accompanied by a teacher. Students can actively interact with the learning material, and build their own knowledge, so that the understanding gained becomes deeper. According to [8] the use of interactive multimedia in learning can help teachers provide a technology-based constructivism learning environment, where students can solve problems through self-exploration, collaboration and active participation. The results of the study [9] indicate that the learning outcomes of students who use flash player learning media are higher than students who use conventional learning media. There is an effect of instructional media and SRL on learning outcomes, where students with high SRL get higher learning outcomes when using flash player learning media compared to students using conventional media.

This study aims to develop interactive multimedia on wetland context-algebraic material. Describe students' SRL skills after learning using interactive multimedia forms-algebraic wetlands context. Analyzing the effect of students' self-regulatory learning abilities on their learning outcomes after learning the Operation of Algebraic Forms in the context of wetlands with the help of interactive multimedia. The results of the study are expected to assist teachers in determining alternative learning media that can help students organize their own learning and ultimately improve student learning outcomes.

2. Methods

The design of this research is development research and descriptive research. Development research uses the ADDIE model [10]. Eligibility is determined based on material and media validation, student learning outcomes, and teacher and student responses. Material validation was carried out by two Mathematics Education experts, while media validation was carried out by two Computer Science Education experts. The material validation questionnaire instrument consisted of 20 statements sourced from the Indonesian National Education Standards Agency (BNSP) [11]. The media validation questionnaire consisted of 11 statements sourced from the Learning Object Review Instrument (LORI) Version 2.0 of 2009 [12]. Material and media validation is determined based on the percentage of achievement (PC) of the expected score. The criteria for the validity of the material and media are determined based on Table 1. Multimedia is said to be valid if the results of material and media validation show a high minimum of validity.

Table 1. Material and media validity criteria.

Percentage of achievement	Criteria
$PC \leq 25$	Low validity
$26 < PC \leq 50$	Moderate validity
$51 < PC \leq 75$	High validity
$76 < PC \leq 100$	Very High validity

The application test was conducted at SMP Negeri 9 Banjarmasin. The analysis of learning outcome data is based on the Minimum Completion Criteria (KKM) values set by the school. The KKM for mathematics at SMPN 9 Banjarmasin is 70. Students are said to be complete if their learning outcomes are at least 70. Multimedia is said to be effective if at least 80 percent of students are complete.

The teacher and student response questionnaire instruments, respectively consisting of 30 and 12 statements, were designed using a Likert scale. Teacher and student responses are said to be positive if they have a minimum agreeing mode. Multimedia is said to be feasible if it is declared valid, effective and gets a positive response from teachers and students.

The SRL questionnaire was used to collect data on students' self-regulation learning abilities. The questionnaire consisted of 14 positive statements adapted from [13] and designed using a Likert scale. The questionnaire was tested on seventh grade students of SMP Negeri 2 Banjarmasin on August 28, 2020. The test results showed that the questionnaire was valid and reliable with a reliability coefficient of 0.67. From the student's SRL ability data collected, the final score (NA) is calculated using the formula

$$\text{NA}=\frac{\text{Score gain}}{\text{Maximum score}}\times 100 \quad (1)$$

Because the highest score was 56, and the lowest was 14, then the NA range was from 25 to 100. Furthermore, based on the final score, students' SRL ability were qualified by referring to Table 2.

Table 2. Material and media validity criteria.

NA	Criteria
$75{,}0 \leq \text{NA} \leq 100$	High
$60{,}0 \leq \text{NA} < 75{,}0$	Moderate
$25{,}0 \leq \text{NA} < 60{,}0$	Low

Analysis of the relationship between SRL and learning outcomes was carried out using a simple linear regression test. The final value of SRL is transformed into interval data as the independent variable and learning outcomes as the dependent variable.

3. Results

The research was conducted from January to October 2020. The research stages were carried out well. The content of the application being developed is mathematics on the subject of Algebraic Forms for seventh grade students. This material consists of eight sub-topics. Apart from being presented in the form of a text description, this material also contains mathematical equations. To help students understand the material, it is necessary to design examples of questions interactively. Students not only read the sample questions, but they learn the sample questions by trying to answer the questions given. Thus there is reciprocal communication between applications and users. In addition, to help students find out their level of understanding, when students work on practice questions the application will provide feedback on whether the student's answer is right or wrong. Thus it is hoped that it can train students to be self-reliant in learning and can motivate students to study further.

The story questions used are story questions related to the wetland environment which are equipped with illustrated images and animations. It is hoped that the use of wetland environmental content related to students' daily lives will help students understand algebraic form material. It is hoped that the use of pictures and animation will make students more interested in learning and not feel bored.

In addition to helping students' understanding through interaction with applications and linking the material to the wetland environment, to further improve student understanding it is also necessary to provide various quiz questions. Students need to be trained to work on a variety of questions. For this reason, this application is designed to present material based on the concept of drill and practice, where students are given practice on a concept repeatedly. The quiz contains several varied questions,

and is displayed randomly. The evaluation contains various questions covering all the material, and is displayed randomly. The material has been validated by two experts in Mathematics Education FKIP Lambung Mangkurat University (ULM). The results of material validation can be seen in Table 3.

Table 3. Results of material expert validation.

Aspects	ES	AS		PA	Validitas
		Validator 1	Validator 2		
Content	96	42	42	87.5	Very High
Construction	40	20	17	92.5	Very High
Serving	24	10	8	75,0	High
Achievement Total	160	72	67	86.88	Very High

Note: ES = expected score; AS = achievement score; PA = percentage of achievement

The results of the validation show that the teaching material is valid and after being corrected according to the advice of material experts, it can be used as content for the developed application. Application development uses web-based technology which consists of HTML, CSS, Javascript, Json, Firebase, Mathjax, Scratch, Github, and Visual Studio Code. Table 4 shows technology and its use in developing interactive multimedia applications.

Table 4. Technology Used.

Technology	Use
HTML, CSS	Arrange and design the display layout in the form of text, images, videos, and animations
JavaScript, scratch	Provide response from user input so it becomes interactive
Json, Firebase	Stores data such as a collection of questions, user answers and scores
Mathjax	Write down math symbols
Visual Studio Code	A place to write code or code worksheets
Github	Hosting multimedia to the internet

The result of the development is in the form of interactive multimedia applications on algebraic form material. The application has been validated by two validators from the Computer Science Education FKIP ULM. Table 5 shows the results of media validation.

Table 5. Results of media validation.

Aspects	ES	AS		PA	Validity
		Validator 1	Validator 2		
Feedback and Adaptation	8	3	3	75.00	High
Presentation Design	56	23	21	78.57	High
Interaction Usability	24	12	9	87.50	Very High
Achievement Total	88	38	33	80.68	Very High

Note: ES = expected score; AS = achievement score; PA = percentage of achievement

The results of media validation show that the application developed is declared valid by media experts. After improvements are made in accordance with the suggestions of the validator, the developed interactive multimedia can be used in learning. Then the application is uploaded to the web and ready for use. Figure 1 shows a display of the multimedia home page.

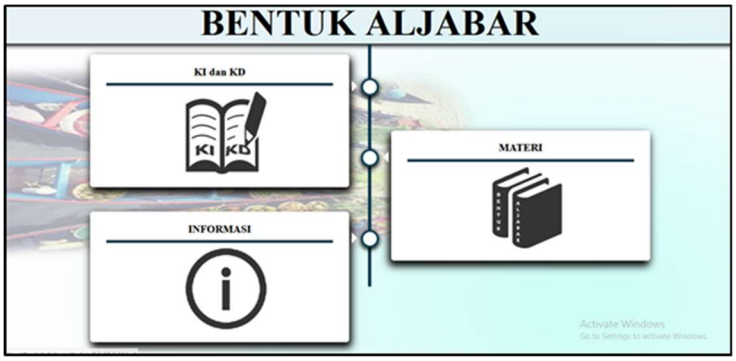

Figure 1. Home page.

The home page is the display that first appears when interactive multimedia is first opened, on this page there are three menus, namely the material menu, the KI and KD menu, and the information menu. The KI and KD menus contain descriptions of the core competencies and basic competencies of the algebraic form material. The information menu contains general information about multimedia and information about the development team. The material menu contains eight sub menus, and each sub menu contains a description of the material, sample questions, and quizzes.

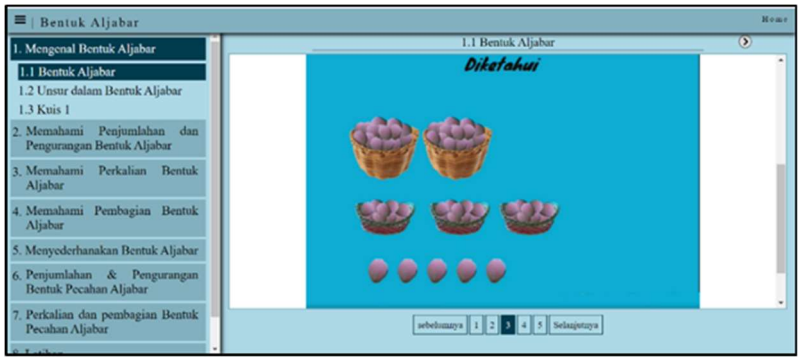

Figure 2. Discussion of sample questions about kasturi fruit.

The algebraic form material is related to the wetland context. Figure 2 shows part of the material description using musk fruit which is a typical fruit in South Kalimantan to introduce the concept of variables, while Figure 3 relates to Banjar culinary. In the material description there are examples of questions that are made interactive, or use animation. After the material description and sample questions, there are many questions that students can do to improve their understanding and skills, as shown in Figure 3 and Figure 4.

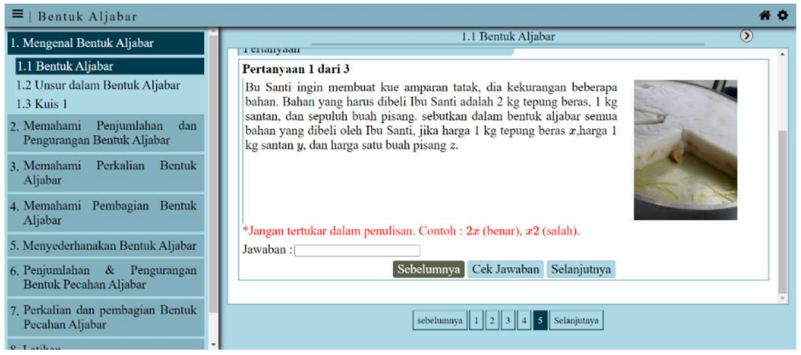

Figure 3. Example questions using the Banjar culinary context.

After the user has finished answering the question, the user can see the results of the answer by pressing the Check Answers button, the application will provide a response to the user's answer. In one sub material there are two to three types of questions. For each type of question there are four to five questions that can be done repeatedly. The Change Question button in Figure 4 allows you to change the question to be displayed.

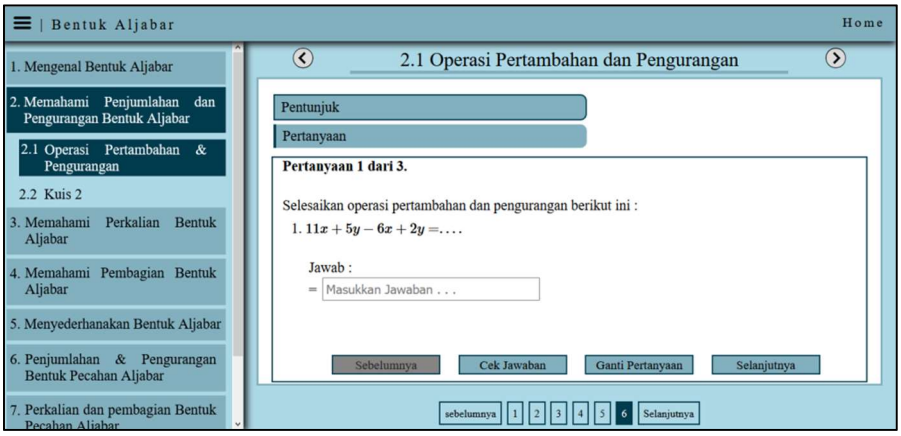

Figure 4. Interactivity in multimedia.

At the end of each sub-material there is a quiz to measure students' understanding of the sub-material that has been studied. After finishing studying all the material, an exercise menu is provided. This menu contains evaluation questions for the entire material. The evaluation consists of 20 multiple choice questions, which will be displayed randomly. The evaluation page can be seen in Figure 5.

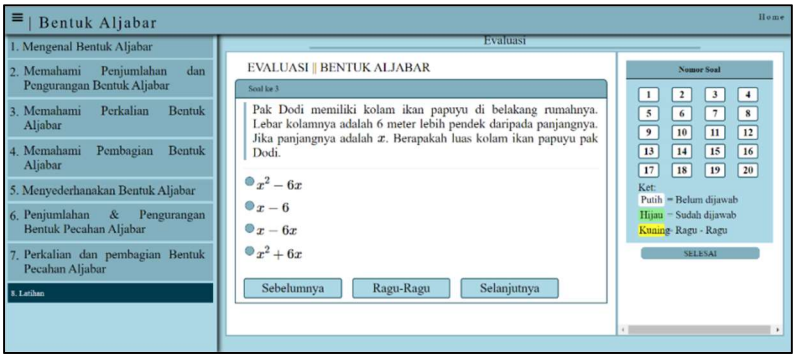

Figure 5. Evaluation page.

The trial was conducted at SMP Negeri 9 Banjarmasin from August 18 to September 29 2020. Lessons were conducted nine times, and the meeting took place in ten tests. Learning is carried out in accordance with the lesson schedule at school, each meeting is held for 90 minutes. Due to the COVID-19 pandemic conditions, learning was carried out online which was attended by 20 students. During learning, students are at home, while teachers are at school. Learning materials are provided in the form of interactive multimedia which has been uploaded on the web. At each meeting only one subject is studied, so that the menu that can be accessed by students is only the material to be studied and what has been studied. Then gradually finally they can access the whole material.

Table 6. Distribution of student learning outcomes

Category	Percentage
Completed	80.0
Not complete	20.0

The average value of student learning outcomes is 70.5 in the moderate category. Based on Table 6 it can be seen that 80 percent of students have finished learning, thus this multimedia is effective.

The teacher gives a positive response to learning using interactive multimedia, with an agree mode. While student responses to learning using interactive multimedia can be seen in Table 7. Students give a positive response to learning using interactive multimedia, with the response mode strongly agree.

Table 7. Distribution of student responses

Aspects	Persentage			
	TD	D	A	SA
This learning media is easy to access and use	0.0	30.0	5.0	65.0
This learning media increased my motivation in learning	0.0	20.0	0.0	80.0
True or false information about my work on this learning media can help me understand the material	0.0	15.0	5.0	80.0
True or false information about my work made me interested in studying the material on this learning media	0.0	15.0	0.0	85.0
Sentences on learning media are simple and easy to understand	0.0	15.0	0.0	85.0
This learning media helps me learn independently	0.0	15.0	0.0	85.0
I can learn algebraic form material with this learning media without the help of others	0.0	50.0	10.0	40.0
I can do evaluation questions without cheating.	0.0	15.0	0.0	85.0
This learning media increased my interest in learning	0.0	20.0	0.0	80.0
This learning media can create a pleasant learning atmosphere	0.0	25.0	10.0	65.0
The material presented in this learning media is easy to understand	5.0	20.0	0.0	75.0
Practice questions, quizzes and evaluation helped me to better understand the material	0.0	15.0	0.0	85.0
Mode	Strongly agree			

Table 8 shows the distribution of students' SRL skills after learning using interactive multimedia. The mode of the student's SRL ability is moderate qualification.

Table 8. Distribution of students' SRL abilities.

Category	Percentage
High	39.3
Moderate	50.0
Low	10.7

Based on the results of the linear regression test in Figure 6, a significance value of 0.172379799 is obtained which is greater than 0.05. Thus H_0 is accepted. This means that there is no significant effect of students' SRL skills on their learning outcomes.

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.317619811
R Square	0.100882345
Adjusted R Square	0.050931364
Standard Error	15.795732
Observations	20

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	503.9073111	503.9073	2.019627	0.172370799
Residual	18	4491.092689	249.5051		
Total	19	4995			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	107.2206544	26.07923551	4.111342	0.000655	52.43021371	162.011095	52.43021371	162.011095
X Variable 1	-0.527947791	0.371497079	-1.42114	0.172371	-1.308434193	0.252538611	-1.308434193	0.252538611

Figure 6. Output of simple linear regression test

4. Discussion

Interactive multimedia on algebraic form material with a wetland context for seventh grade has been declared valid in terms of material and media, effective and has received positive responses from teachers and students. Thus, this multimedia is suitable for use in seventh grade learning.

Learning outcomes show that 80 percent of students have completed learning. This supports the research results that the use of interactive multimedia improves students' English learning outcomes [14], and science learning outcomes [15]. The results of this study are also in line with the results of research [16] which stated that the learning outcomes of students who received interactive multimedia learning were better than those of students who received learning without interactive multimedia. Students and teachers in general gave a positive response to the use of interactive multimedia material in the seventh grade algebraic form in wetland context. Students stated that they were more motivated and independent in learning, and the use of interactive multimedia made learning mathematics more fun. This is in line with the results of research [17, 18] and results of research [19], which found that the use of interactive multimedia makes learning less boring, and students become more motivated to learn. Interactive multimedia makes students more active in learning by involving many senses. Students who use multimedia will read, see, hear, and actively manipulate the material. They can control the order and tempo of the material, thereby enabling students to learn at their own pace in a tailored learning environment [20, 21, 22].

The use of a wetland context helps students understand the material. Like the results of research [5, 23, 24] which found that the use of students' daily contexts in mathematics material made it easier for students to understand the material being studied, thereby increasing their learning outcomes. However, as expressed [25], teachers need to facilitate discussion with questions that support students to develop from context to more formal mathematics. In this case, interactive multimedia acts as a teacher or tutor who displays questions that guide students from context to formal mathematics. The application will provide feedback on student answers. And students can change the answer every time the application scores their answer wrong, until the correct answer is obtained.

Students 'SRL abilities are at moderate qualifications, and there is no significant effect of students' SRL abilities on learning outcomes after using interactive multimedia. This is different from the results of studies [26, 27, 28]. This result is also different from the results of research [9] which states that there is an effect of student learning media and SRL on learning outcomes using flash player learning media. Further research is needed with more subjects to see the effect of students' SRL ability on learning outcomes after learning using interactive multimedia.

5. Conclusion

Interactive multimedia on algebraic form material with a wetland context for grade seven has been declared valid, effective and has received a positive response from teachers and students. Thus, this multimedia is suitable for use in seventh grade learning. Student's SRL ability is in moderate qualification, and there is no significant effect of students' SRL ability on their learning outcomes. Further research is needed with more subjects to see the effect of students' SRL ability on learning outcomes after learning using interactive multimedia.

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