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DeLone and McLean Model Evaluation of Information System Success: A Case Study of Master Program of Civil Engineering Universitas Lambung Mangkurat

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Abstract

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This paper examines the adaptation of the DeLone and McLean information system success models that are commonly used in the university's information systems domain. The survey design model was used in this study with 29 structured questionnaire items through Google forms used to collect data from 98 respondents, they were students, lecturers, and administrative staff in the Master Program of Civil Engineering Universitas Lambung Mangkurat Banjarmasin Indonesia. Structural equation modeling is used to test construct models. The results of data analysis showed that the quality of the system affected the use ($\beta = 0.61, p < 0.001$) and user satisfaction ($\beta = 0.22, p < 0.001$). Information quality affects usage ($\beta = 0.30, p < 0.001$) and user satisfaction ($\beta = 0.29, p < 0.001$). Also, service quality affects usage ($\beta = 0.28, p < 0.001$) and user satisfaction ($\beta = 0.55, p < 0.001$). However, use did not affect user satisfaction ($\beta = 0.00, p > 0.05$) but influenced individual impact ($\beta = 0.32, p < 0.001$) and organizational impact ($\beta = 0.19, p < 0.001$). User satisfaction affects individual impacts ($\beta = 0.28, p < 0.001$) and organizational impacts ($\beta = 0.17, p < 0.001$). Individual impacts affect organizational impacts ($\beta = 0.73, p < 0.05$). The quality of the system, the quality of information, and the impact of the individual are the determining factors for the success of the information system at the university so it is very important that the information system at the university is designed so that it is easy to use, flexible, and functional to meet its objectives.

Keywords: DeLone and McLean Model, system, information, quality, intention, satisfaction, impact.

1 Introduction

The field of information technology has developed significantly in recent years. Today, companies rely on a wide range of information systems to provide quality services and gain a competitive edge over their rivals in the market. Furthermore, there have been significant investments in systems that can improve the timely realization of short-term and long-term business goals. In some cases, the focus is on continuously evaluating the information systems to determine their effect on the organization as a whole and its employees (Gable et al., 2008). The efforts have further been motivated by the realization that the failure of the information system is a serious issue that can lead to time and cost overruns. It can also cause an organization to lose its competitive edge in the current dynamic and highly globalized world.

The implementation of information system projects can be a costly affair for any organization because of the requirements involved. A significant number of projects can fail because of various factors that include a lack of expertise and selection of the wrong tools. Available research evidence shows that a great number of projects are usually canceled before completion. Possible reasons for cancellation include system failure, cost, time overruns, and the emergence of new technologies. Companies continue to view information systems as an avenue for improving their effectiveness and meeting the needs of customers (Mkoba & Marnewick, 2016). To ensure minimal losses associated with information system projects, there is a need to evaluate them carefully before they are launched. This process entails examining how effective the systems are in improving everyday operation and how they can be successfully implemented in the organization. Presently, researchers have yet to reach a consensus on the measures to use when examining the effectiveness and impact of the information

systems (Rockart & Flannery, 2015; Bossen, Groth, & Jensen, 2013). Results of previous studies reveal that researchers focus on diverse measures when examining the issue of information systems. This approach has led to the development of diverse parameters related to the effect of the information systems on everyday operations. It is also imperative to state that the success of an information system may depend on factors that include size of the enterprise, management methods, and measurement approaches used by the project team. Therefore, managers are expected to explore various aspects of the information systems and develop systems that can assist in evaluating their suitability and success.

The DeLone and McLean model are one of the most commonly used frameworks for assessing the effectiveness of information systems (Iivari, 2005; Petter et al., 2013). The approach was developed to provide an avenue through which project teams can measure the performance of information systems and generate evidence that can be used to predict the factors for success. In some instances, the focus is on determining how the systems can influence organizational outcomes that are specific to a given sector (Petter et al., 2013; Sedera, 2006). Besides attempts have been made to examine the relationship between different dimensions of the model and the successful implementation of information systems. The outcomes of the projects have been mixed but have still provided information that can help managers make informed decisions about the use of different technological systems. The objective of the current study is to investigate the success of an information system using the DeLeon and McLean Model. In this case study, data was collected from the Civil Engineering Master Program of Universitas Lambung Mangkurat, Banjarmasin, Indonesia.

2 Theoretical background

The topic of information systems has attracted the attention of researchers over the years. They are described as organizational, formal, and sociotechnical systems that are used in the collection, storage, processing, and distribution of data (Bossen, Jensen, & Udsen, 2013; Lee & Yu, 2012; Nwankpa & Roumani, 2014). From a socio-technical point of view, information systems are usually made up of structures, technology, people, and tasks. In addition, they are designed in a way that allows people to process and interpret different kinds of information that will improve the delivery of services. Some researchers have noted that the information system is a unique academic study of technologies that are used in collecting, filtering, and distributing data (Jensen & Udsen, 2013; Lee & Yu, 2012). The systems have definitive boundaries depending on the activities that are to be performed. The analyzed data is used in supporting operations, decision-making, and management. It is worth stating that information systems can include different ICT components that are used in the current dynamic and competitive market.

More recently, there have been attempts to categorize information systems based on the type of work they perform (Lee & Yu, 2012; Youssef & Meriouhb, 2015). In this sense, the systems are made up of structures in which machines or people carry out different types of tasks to produce the desired outcomes and meet the needs of clients (Lee & Yu, 2012; Nwankpa & Roumani, 2014). Such systems are designed to aid in capturing, transmitting, storing, and retrieving information, depending on the tasks that are to be performed. In this perspective, the information system can be made up of a wide range of data subsystems that allows for specific communication and processing methods. A review of the existing technology reveals that the nature of the organization tends to influence how information systems are developed and put into use (Lee & Yu, 2012; Youssef & Meriouhb, 2015). The utilization of technology may entail a wide range of methods, such as the system development life cycle, to create systems that are capable of performing the desired processes. Recent investigations reveal that modern enterprise can also decide to outsource information systems to accomplish the goals on time and within organizational budgets (Lee & Yu, 2012; Nwankpa & Roumani, 2014).

The quality of life of citizens can be influenced by their level of education to a larger extent (Powdthavee, Lekfuangfu, & Wooden, 2015; Oreopoulos & Salvanes, 2011; Psacharopoulos & Patrinos, 2004). It is against this background that attempts are always made to improve the quality of education and give learners access to better services and programs in institutions of higher learning (Brighouse, 2006; Chen, 2012; Clark, Frijters, & Shields, 2008; Frey & Stutzer, 2000; Leigh & Ryan, 2008). Also, there have been efforts in Indonesia to enhance the available degree programs and ensure

that they align with market demands. The Civil Engineering Graduate Program is one of the major courses of study that students can pursue at Universitas Lambung Mangkurat in Banjarmasin. The degree is meant to enable students to acquire the knowledge and skills they need to plan, design, and construct various structures, bridges, buildings, and roads. The program enables learners to understand how to carry out operational evaluation programs, engage in cutting-edge research on different elements of civil engineering, and continue their education in other related fields. Those who are recruited into the program can learn about structural, construction, transportation, and environmental engineering. Universitas Lambung Mangkurat has distinguished itself as a major provider of quality education that can help students succeed in their professional lives and work in competitive and dynamic environments. In addition, it allows students to engage with experts and stakeholders in the field of civil engineering. Those who undertake the program may also work with other researchers in fields like medicine, public health, and mechanical engineering to address some of the major challenges affecting communities today.

The implementation of information systems is critical to the delivery of quality education and instruction in complex courses such as civil engineering. It is also imperative to state that the process of implementing information systems may require significant capital investment with high expectations of return in the future (Bossen, Jensen, & Udsen, 2013). Therefore, it is critical to evaluate the success of the systems and identify areas that should be changed to realize optimal results. The success and importance of information systems is an ongoing area of interest for managers, researchers, and industry practitioners. The information collected through these evaluations can help stakeholders determine the value of the systems and serve as the foundation for subsequent decisions regarding the projects (Caldeira & Ward, 2003). Today, a wide range of methods have been developed and used to assess information systems. DeLone and McLean stand out as one of the models commonly used in diverse fields over the years. The model usually provides six integrated measures of the success of information systems. These include perceived information quality, perceived system quality, intention to use, user satisfaction, individual impact, and organizational impact.

It is important to state that the DeLone and McLean guides have been used successfully in previous studies to examine the impact of information systems. Some areas where it has been utilized include the assessment of e-commerce systems, knowledge-based management tools, and e-government structures. In some cases it has been used to assess the effect of health information projects. These studies have noted that the quality dimensions of the information systems can determine whether they will be used to successfully achieve the desired results. In this sense, researchers have presented the model as providing vital information about the nature and impact of various systems in different industries.

3 Research method

The current study was based on the model by DeLone and McLean. Its focus was on assessing the utility of information systems that have been used in the selected university. Researchers evaluated the quality of each information system by focusing on the six major elements of the DeLone and McLean Model. The focus was also on determining the correlation between information quality, system quality, intention to use, user satisfaction, individual impact, and organizational impact. The constructs were operationalized in the study, as explained below.

- System quality: System quality refers to the measure of the desirable features of the information system being assessed. This variable can be measured using elements such as perceived ease of use, response time, flexibility, and functionality. In previous studies, the variable has also been assessed based on measures such as the responsiveness and assurance of the developers. Also, other researchers have explored measures based on training opportunities and technical assistance. For the study, the researcher concentrated on issues such as the infrastructure that had been put in place to ensure that the information system would always be functional and reliable.
- Information quality: This variable relates to the characteristics of the output of the information systems and factors related to the content delivered to the users. It can be

measured by evaluating the accuracy, timeliness, reliability, and trustworthiness of the system. In this case, the focus was on determining whether the systems being assessed were timely, useful, and capable of providing correct data.

- **Intention to use:** Intention to use was assessed by examining the way various people utilized the information systems. The process entailed conceptualizing and capturing variables such as actual usage and frequency of utilization. Depending on the nature of the system, people used it to carry out a wide range of functions such as storage and processing of information. Therefore, it was important to understand the perceived usefulness of the system that was being examined in the present study.
- **User satisfaction:** This is one of the most important elements of the model identified as the basis for this study. It shows the success of the systems and how the users feel about their implementation. The variable was evaluated based on the feelings of the people who use the information systems and the extent to which they think their informational needs have been met.
- **Individual impact:** This variable refers to the measure of the effect of the information system on the behavior of the recipients or users. The individual impact is closely related to the manner in which the systems affect the quality of the work environment, decision-making, job performance, work quality, and job effectiveness.
- **Organizational Impact:** The variable shows the extent to which the information system is contributing to the success of the organization. Organizational impact also shows the degree to which information systems will affect organizational performance. The variable can either be positive or negative depending on its actual impact and the resources that have been invested into the profits.

In this study, the model guidance is presented in Figure1 and based this, the focus was on the following twelve hypotheses as shown below.

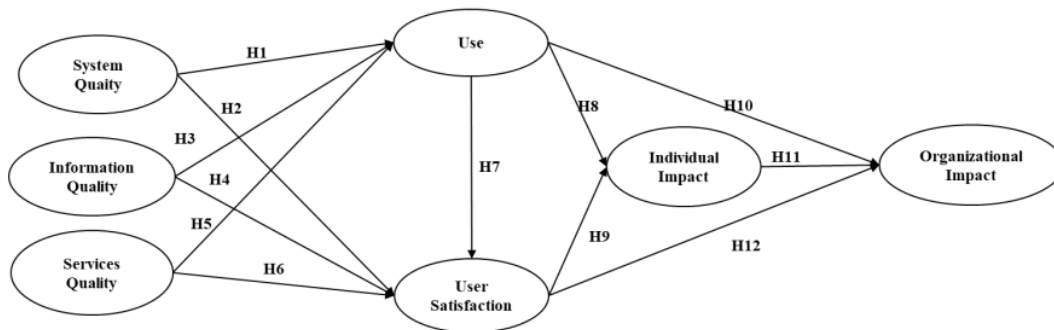


Figure 1. Research Model

1. H1: System quality will influence significantly use.
- H2: System quality will influence significantly user satisfaction.
- H3: Information quality will influence significantly use.
- H4: Information quality will influence significantly user satisfaction.
- H5: Service quality will influence significantly use.
- H6: Service quality will influence significantly user satisfaction.
- H7: Use will influence significantly user satisfaction.
- H8: Use will influence significantly individually impact.
- H9: User satisfaction will positively affect individual impact.
- H10: Use will influence significantly the organizational impact
- H11: Individual impact will influence significantly organizational
- H12: User satisfaction will influence significantly the organizational impact

The total sample in this research is 98 respondents selected through random sampling from Master Program of Civil Engineering Universitas Lambung Mangkurat Banjarmasin Indonesia. To answer the 12 research hypotheses, structural equation modeling (SEM) is used with calculations using the AMOS. The data was analyzed with stepwise confirmatory factor analysis was run to make sure the model's goodness-of-fit and subsequently, the psychometric properties of the model were evaluated in terms of composite reliability and convergent validity, and finally, the paths coefficients of the model were examined.

A questionnaire was developed with the aim of answering all previously formulated research hypotheses. The total number of questionnaire items was 29, all of which were abstracted from previous researchers. For data collection, instruments that have been developed are then entered into Google forms with links distributed to 98 respondents to be filled with a period of approximately 10 days.

4 Results

In achieving the goodness-of-fit model regarding to the data collected, six model-fit measures are used: the chi-square ratio, GFI (goodness-of-fit index), AGFI (adjusted goodness-of-fit index), NFI (normalized fit index), RMSR (root mean square residual), and RMSEA (root mean square error of approximation) with result showed in Table 1.

Table 1. Model fit indices

Fit index	Recommended value	Obtained value
Chi-square ratio (X^2/df)	≤ 3.00	2.81
GFI	≥ 0.90	0.94
AGFI	≥ 0.80	0.83
NFI	≥ 0.90	0.93
CFI	≥ 0.90	0.94
RMSR	≤ 0.10	0.08
RAMSEA	≤ 0.08	0.07

The research model as shown previously, tested the reliability, reliability of the construct, and the validity of each item. If the loading factor is more than 0.7 then the item is considered good. Table 2 shows that all items have a standard load greater than 0.7. Furthermore, construct reliability is assessed using CR (composite reliability) as a measure of internal consistency, while convergent validity is assessed by determining the AVE (average extracted variance). Table 2 shows that this model is reliable and has acceptable convergent validity, because CR and AVE exceed 0.7 and 0.5, as recommended by Nunnally and Bernstein (1994).

Table 2. Composite reliability and average variance extracted

Variables	Item	SD	CR	AVE
System quality	I find the IS-GPCE in GPCE	0.80	0.82	0.61
	I find easy to get the IS-MPCEULM to do what I want	0.77		
	The IS-MPCEULM is flexible to interact with	0.74		
	Learning to operate IS-MPCEULM was easy for me	0.73		
Information quality	The information generated by the IS-MPCEULM is correct	0.79	0.84	0.69
	The information generated by the IS-MPCEULM is useful for its purpose	0.74		
	The IS generates information in a timely manner	0.73		
	I trust the information output of the IS-MPCEULM	0.79		
Service quality	There is adequate technical support from the system's provider	0.73	0.82	0.62
	The overall infrastructure in place is adequate to support	0.77		

	the IS-MPCEULM ¹⁰			
	The IS-MPCEULM can be relied on to provide information when needed	0.79		
	The output of the IS-MPCEULM is complete for work processes	0.81		
Use	Using the IS-MPCEULM enables me to accomplish tasks more quickly	0.70	0.89	0.77
	Using the IS-MPCEULM has improved my job performance	0.75		
	Using the IS-MPCEULM has made my job easier	0.79		
	I find the IS-MPCEULM useful in my job	0.77		
User satisfaction	I am satisfied with the functions of the IS-MPCEULM	0.77	0.80	0.54
	The IS-MPCEULM has eased work processes	0.74		
	I am generally satisfied using the IS-MPCEULM	0.76		
Individual impact	The IS-MPCEULM will help overcome the limitations of the paper-based system	0.77	0.89	0.60
	Using the IS-MPCEULM will cause an improvement in patient care delivery	0.77		
	The IS-MPCEULM facilitates easy access to student's information	0.78		
	The IS-MPCEULM will enhance communication among stakeholders	0.79		
	IS-MPCEULM use will cause improved decision making	0.77		
Organizational impact	IS-MPCEULM Increase Organizational Productivity	0.78	0.88	0.59
	IS-MPCEULM increase Organizational competition position	0.77		
	IS-MPCEULM Organizational profitability	0.81		
	IS-MPCEULM Increased organizational revenue	0.79		
	IS-MPCEULM Improved organizational performance	0.77		

IS-MPCEULM: information system ¹⁵ master program of civil engineering Universitas Lambung Mangkurat, SD: standard loadings, CR: composite reliability, AVE: average variance extracted.

The results of SEM analysis with AMOS are shown ²¹ in Figure 2 and Table 3 where there is one hypothesis (H7) that is not significant, and the rest (H1, H2, H3, H4, H5, H6, H8, H9, H10, H11, and H12) are significant.

The structural model further shows that use and user ⁴⁴ satisfaction together constitute about 19% of the total variance of individual impact. The construct of system quality, information quality, and service quality together constitute about 42% of the total variance of use and about 73% of the total variance of user satisfaction. Also use, individual impact, and user satisfaction together constitute about 27% of the total variance of organizational impact.

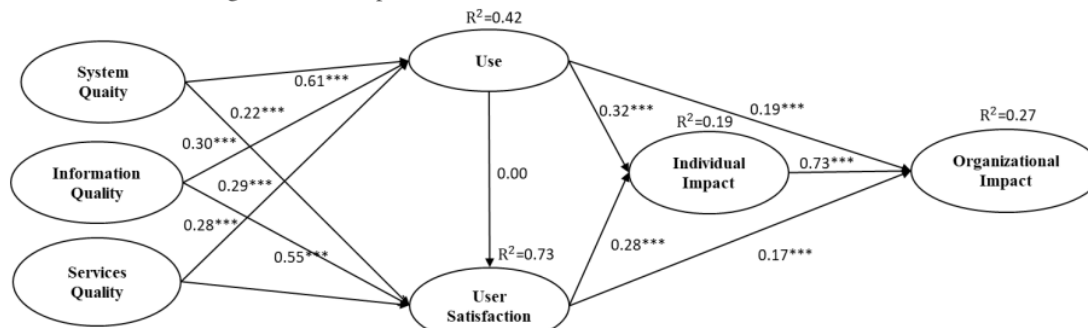


Figure 2. Structural equation model

Table 3. Path Coefficients

Hypotheses	Path	Beta	P-value	Remarks
H1	System quality → Use	0.61	< 0.001	Accepted
H2	System Quality → User Satisfaction	0.22	< 0.001	Accepted
H3	Information Quality → Use	0.30	< 0.001	Accepted
H4	Information Quality → User Satisfaction	0.29	< 0.001	Accepted
H5	Service Quality → Use	0.28	< 0.001	Accepted
H6	Service Quality → User Satisfaction	0.55	< 0.001	Accepted
H7	Use → User Satisfaction	0.00	< 0.914	Rejected
H8	Use → Individual Impact	0.32	< 0.001	Accepted
H9	User Satisfaction → Individual Impact	0.28	< 0.001	Accepted
H10	Use → Organizational Impact	0.19	< 0.001	Accepted
H11	Individual Impact → Organizational Impact	0.73	< 0.000	Accepted
H12	User Satisfaction → Organizational Impact	0.17	< 0.001	Accepted

5 Discussion

The current study validated the usefulness of the DeLone and McLean Model based on the information collected regarding the success of information systems at Universitas Lambung Mangkurat, Banjarmasin. Also, the results show that the framework can be applied to different contexts and industries, including the healthcare sector. Generally, the findings show an important and complex interrelationship between systems quality, user satisfaction, individual impact, and organizational impact. Although the construct of the model may not always have a standard or conventional psychometric property, it can still be used to assess the effects as well as the success of information systems in the education sector.

Specifically, the result revealed that system quality significantly influenced the use, service quality significantly influenced user satisfaction, and individual impact significantly influenced the organizational impact of the university information system. The findings are in agreement with the outcome of previous studies, which have revealed that the information systems can be evaluated and understood based on the six elements of the DeLone and McLean Model (Wu & Wang, 2006; Wang & Liao, 2008; Choi et al., 2013; Bharati & Berg, 2005). It is also imperative to state that it was not easy to capture the actual effect of the service quality on the use of the information model that was being assessed.

Service quality was found to influence the use of the information system and the individual impact that users were likely to see in the interventions (Baraka, Baraka, & El-Gamily, 2013; Jiang, Yu, Hailey, Ma, & Yang, 2016; Yu & Qian, 2018). This implies that institutions should strive to encourage people to use the information systems by implementing them in a manner that will lead to the realization of the desired outcome, such as the storage and processing of information (D'Ambra & Rice, 2001; Hackney, Jones, & Lösch, 2007). In addition, the system should not only be flexible but also functional and easy to use. When systems are not safe, reliable, and accurate, users will not see their benefits and may cease relying on them to achieve the desired results.

The other critical issue determined in the current study was that user satisfaction had a significant impact on the individual and organizational impact in comparison to the intention to use. Furthermore, the quality dimension of the information systems had a vital and positive influence on user satisfaction. The results appear to agree with those of previous studies that have been done in diverse contexts, including in hospitals and for-profit organizations (Ojo & Popoola, 2015; Ojo, 2017; Saghaeiannejad-Isfahani, Saeedbaksh, Jahanbaksh, & Habibi, 2015; Jaafreh, 2017). It is

imperative to point out that service quality tends to be a critical factor determining the level of user satisfaction with information systems (D'Ambra & Rice, 2001; Doll & Torkzadeh, 1998; DeLone & McLean, 1992; Etezadi-Amoli & Farhoomand, 1996; Liu & Arnett, 2000). In this sense, it could be concluded that an information system is regarded as successful based on the net benefit and its continued use by various stakeholders (DeLone & McLean, 2014). Furthermore, there is a need to pay attention to the quality of the services achieved or delivered by the systems (Rai, Lang, & Welker, 2002; Teo & Choo, 2001; Wang, 2008; Brown & Jayakody, 2008). The results also agree with studies done in various sectors, such as the healthcare industry, that have highlighted the need to focus more on the quality of services as a way of improving the level of user satisfaction (Tilahun & Fritz, 2015; Cho et al., 2015; Ojo & Popoola, 2015; Ojo, 2017; Saghaeiannejad-Isfahani et al., 2015; Jaafrehr, 2017). However, the context, as well as the nature of the systems, may also be factors determining the results gathered by researchers using the DeLone and McLean Model.

The results provided in this study show that the evaluated information system had been successful and provided users with an avenue through which they could carry out educational activities in the institution. Therefore, it has important theoretical and managerial implications. From a theoretical perspective, it was evident that most of the study hypotheses were confirmed. Also, it was determined that there was a positive and influential relationship between information quality and user satisfaction, intention to use, system quality, and individual impact. In this regard, it is apparent that the study offers vital information that can be used as the basis for evaluating an information system and its use in the education sector. Based on the findings presented here, researchers can conduct further investigations to determine the positive and significant relationships among the various elements of the DeLone and McLean framework (Tilahun & Fritz, 2015; Cho et al., 2015). In addition, studies can be done to explore how the nature of the systems and the areas of implementation can affect the success of the projects. The outcome of these studies can be used as the basis for predicting how users will respond to the implementation of an information system and the extent to which they will use it in their everyday lives.

From a managerial perspective, the results show how productivity and the usefulness of the information systems can be improved. Furthermore, they show how managers can increase customer satisfaction by facilitating the exchange of data and gaining a competitive edge in the market. When managers understand the nature of the systems in question and how users assess them, they will be better positioned to make sufficient allocations for resources needed to enhance information and service quality (DeLone & McLean, 2016; Alter, 2008; Bartis & Mitev, 2008). Also, the managers will be able to analyze internal and external factors that will determine how people respond to information system projects. Within the education sector, faculty leaders should be encouraged to assess and analyze the reliability of information systems and predict their potential effects based on various tools such as the DeLone and McLean framework (Burton-Jones & Straub, 2003, 2006; D'Ambra & Rice, 2001). The indicators of success can help them develop plans needed during the implementation of the projects. Moreover, they will know and understand the changes that need to be made to ensure that the projects are a success.

6 Conclusion and Recommendations

Today, organizations make large and significant investments in information systems. These systems are supposed to provide information and data that can be used to meet the needs of clients and contribute to the realization of short- and long-term organizational goals. Therefore, there is a need to understand the concept of information system quality and identify factors that should be addressed to ensure that the desired results are realized. From this study, it is apparent that information system quality is a multidimensional concept that can be understood through the use of the right model, such as the DeLone and McLean framework. The current study aimed to assess the possible association between the variables of the information system and other parameters, such as user satisfaction and intention to utilize interventions. Taken together, the results of the current study reveal a significant association between the information systems and service quality, including their impact on the intention to use and the level of satisfaction with the selected program. Also, there is a positive link between the intention to use and the quality of the systems.

From the results, it is also apparent that organizations and managers can enhance information quality, system quality, and service quality to drive more people to use their technologies and enhance those users' satisfaction with them. The DeLone and McLean framework can be used as the basis for assessing the impact of the information systems and evaluating how they can be implemented in different settings, including in schools. It is also worth stating that the findings of the study can help in developing a high-quality information system that is supported by the vendors to ensure that people get access to better services and quality information. The research will contribute to the understanding of information systems in several ways. First, it presents a conceptual framework that can assist in assessing the different elements of information systems. Second, it shows how user perception and satisfaction can be improved in an organizational setting. Managers and researchers can utilize the results of this study to explore the linkage between the measures and constructs related to information systems and the way they can be improved depending on the nature of the work being done and the kinds of services that are needed.

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