Journal of King Saud University – Science 35 (2023) 102566

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Journal of King Saud University – Science

journal homepage: www.sciencedirect.com

Original article

The factors influenced by stakeholder identification in E-learning systems: A survey

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ARTICLE INFO

Article history:
Received 12 June 2022
Revised 11 January 2023
Accepted 12 January 2023
Available online 18 January 2023

Keywords:
E-learning
Stakeholder Identification (SI)
Stakeholder
Quality

ABSTRACT

Identifying the appropriate stakeholder is an integral part of the requirements engineering process and the primary factor influencing system success. The E-learning system is a significant platform with a variety of stakeholders that must be identified. After the launch of the E-learning system, issues such as identifying stakeholders arise and threaten the system's continuity. Moreover, the use of non-scientific and incompatible methods for identifying stakeholders, as well as the limitations of some of these methods, are among other issues that are highlighted in this research. This study investigates the issue of Stakeholder Identification (SI) in the E-learning system and identifies the most influential factors influencing this significant issue. By conducting a comprehensive literature review and employing qualitative data collection and analysis, these factors are addressed. There were 35 survey questionnaires were distributed to experts, analysts, and developers in the field of the E-learning system in Malaysia in 2022 to collect the data. The results reported in this paper demonstrated that there are difficulties in defining the actual stakeholders, as well as a lack of knowledge in employing the appropriate techniques to identify them, which were then analysed and compared to generate the list of factors. The factors identified in this paper help industries understand how critical it is to identify the actual stakeholders of an E-learning system at an early stage. Therefore, industries should be able to develop stable and reliable E-learning systems. This research provides several contributions, including crucial theoretical and practical insights into how E-learning systems are used and adopted. Contributes to the current literature by outlining the key obstacles caused by SI concerns. Identify the most significant components of SI issues, i.e., information quality, time and cost, system utility, and technology. Finally, this paper provides important recommendations for academics, developers, and regulators, allowing them to better understand the critical factors of effective E-learning system implementation.

1. Introduction

With the rapid development of information technology and the urgent need for it in the field of education, the E-learning system became one of the most significant systems. The E-learning system is among the most significant technological part of learning administrations, commonly offers modern, varied, and great services to different groups of the most important stakeholders such as students, instructors, and administrative staff, which makes it an effective system. The high growth of E-learning systems in the last years and the sudden shift from classroom to online education especially during the covid-19 pandemic made this system gain extraordinary attention and thus motivated the research to study

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Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

https://doi.org/10.1016/j.jksus.2023.102566
1018-3647/

the main challenges that negatively affect E-learning systems continuity and stability (Almaiah et al., 2020; Zaguia et al., 2021).

Recent studies emphasized that E-learning systems face challenges in terms of upgrading and promoting the educational process. The efficiency of the E-learning system depends mainly on the quality of software applications while the success of any software relies much on the usage by different stakeholders. Accordingly, we must pay attention to developing it in a way that meets all needs in addition to conducting various research that advances its capabilities to satisfy its stakeholders. Stakeholders are fundamental parts of an institutional structure that require high consideration and they are an effective element of a project to achieve success (Elneel et al., 2022) and the main source of system requirements. Therefore, stakeholders can support the system by providing clear requirements and by defining the basic functions in the system. Students and instructors are considered among the most important stakeholders as they represent the main source of evaluating feedback for the E-learning system (Elneel et al., 2022).

However, SI is a challenging task; it needs more research and clarifications as there are complex activities related to it. The value of E-learning system application depends to a large extent on identifying the appropriate stakeholders, particularly in the requirements engineering process which needs a deep analysis. SI has an impact on a variety of E-learning system elements, both directly and indirectly. According to numerous research (e.g., (Ekuase-Anwansedo et al., 2018; Fritz et al., 2018)), identifying stakeholders early in the development of an E-learning system is the most crucial impediment since the E-learning system has a diverse set of stakeholders which reduces common system difficulties. The goal of this study is to explore the most significant impacted aspects by SI, as well as the magnitude of these aspects' influence on the E-learning system.

The following are the contributions of this paper. First, this paper did a thorough review of the literature on E-learning systems to figure out the factors that SI affects. Second, we surveyed experts from universities, schools, training centers, and the ministry of education to find out how SI affects the most important parts of an E-learning system and to find out what the most common problems with SI are. Also, the results reported in this paper showed that it is hard to figure out who the real stakeholders are, and that people don't know how to use the right techniques to find them. These techniques were then analyzed and compared to make a list of factors. The factors listed in this paper help businesses realize how important it is to find out who the real stakeholders of an E-learning system are at early stage. So, businesses should be able to build E-learning systems that are stable and reliable. Lastly, we talk about the problems and future directions of research for factors that SI affects in the E-learning system.

This study is organized as follows: The following section discusses the SI classification framework and the factors affected by SI in the E-learning system. Section 3 explores the methodology conducted in this research. Section 4 argues the research and analyses the data. Section 5 answers the research question and discusses the factors impacted by SI in the E-learning system. Section 6 discusses the research implications, limitations, and future directions. The final part concludes the paper.

2. Background

2.1. Stakeholder identification and classification framework

Well-identified stakeholders represent the greatest features imperative of E-learning. The absence of connection with SI methodology leads to losing plenty of usefulness for some powerful factors (Zaguia et al., 2021). Consequently, applying SI needs to be done by using well-structured approaches. Each approach needs to be selected depending on the project characteristics in order to identify appropriate stakeholders. Various methods were proposed to investigate stakeholders. The proper process of E-learning SI is based on the stakeholder's skills, knowledge, and responsibilities. This activity increases the prospect of E-learning system achievement. Additionally, it guides the software development phase to a convenient supplement (Bentrad et al., 2020; Dodero et al., 2017).

The process of identifying important stakeholders is depicted in Fig. 1. It begins by determining the project's scope (objective and client constraint), then determining the stakeholders based on their functional roles. Then, before forming a team, evaluate and prioritize the stakeholders. Core, supporting, tertiary, and extended stakeholders are the four categories of stakeholders that might be developed as a result. System development success requires understanding users' needs which is saving time and money by discovering errors from an early stage. In the second stage, the real stakeholders must be identified. Omitting or ignoring identifying the proper stakeholder for an E-learning system is one of the serious issues that need to be examined due to its association with other influences affecting the steadiness of the system. Success in identifying system stakeholders leads to the accomplishment of using the system whereas a lack of E-learning system usage obstructs the fulfillment of benefits (Almaiah & Alismaiel, 2019).

2.2. Factors affected by stakeholders identification

E-learning system requirements studied by a large number of researchers during the past years due to their great impact on the E-learning system enhancement. The implementation of E-learning systems faces several obstructions due to the insufficiency of readiness of E-learning systems. When applying an E-learning system, there are fundamental factors concerning individual, social, and educational issues that should be taken into consideration by decision-makers. One of these obstacles is identifying the proper stakeholders which affects gathering E-learning system requirements and some major factors. These affected elements prevent fulfilling the E-learning system requirements (Martin, 2021).

Almaiah and Alyoussef (2019) and Almaiah et al. (2020) addressed some factors affecting the E-learning system such as course design and content, social support, administrative support, learner and instructor characteristics, and technician characteristics. All these factors depend entirely on who the real stakeholders are because the stakeholders' skills, knowledge, motivation are important issues affecting the previous factors (Naveed et al., 2017). Also, Al-Samarraie et al. (Al-Samarraie et al., 2018) highlighted some factors affecting students' and instructors' satisfaction such as information quality, system quality, and usefulness. Information quality factor is affected by identifying the proper stakeholders because this issue has the effect of collecting correct, accurate, and compatible information, while the system quality and usefulness point to stability, fast response speed, complete tasks, reasonable interface design. All these fundamental elements, the stakeholders play the main role in the extent of their quality (Al-Samarraie et al., 2018).

Flexibility is the students' main concern about E-learning. Flexibility means access from anywhere at any time with the flexibility of updating, which is available by achieving the required objectives of the real stakeholders (Martin, 2021). The diversified stakeholders in E-learning institutions communicate with each other in a variety of methods wherefore the preparedness of an E-learning organization in terms of technical aspects is one of the main readiness that achieve more success. Gathering the requirements from the E-learning system real stakeholders ensure software and hard-

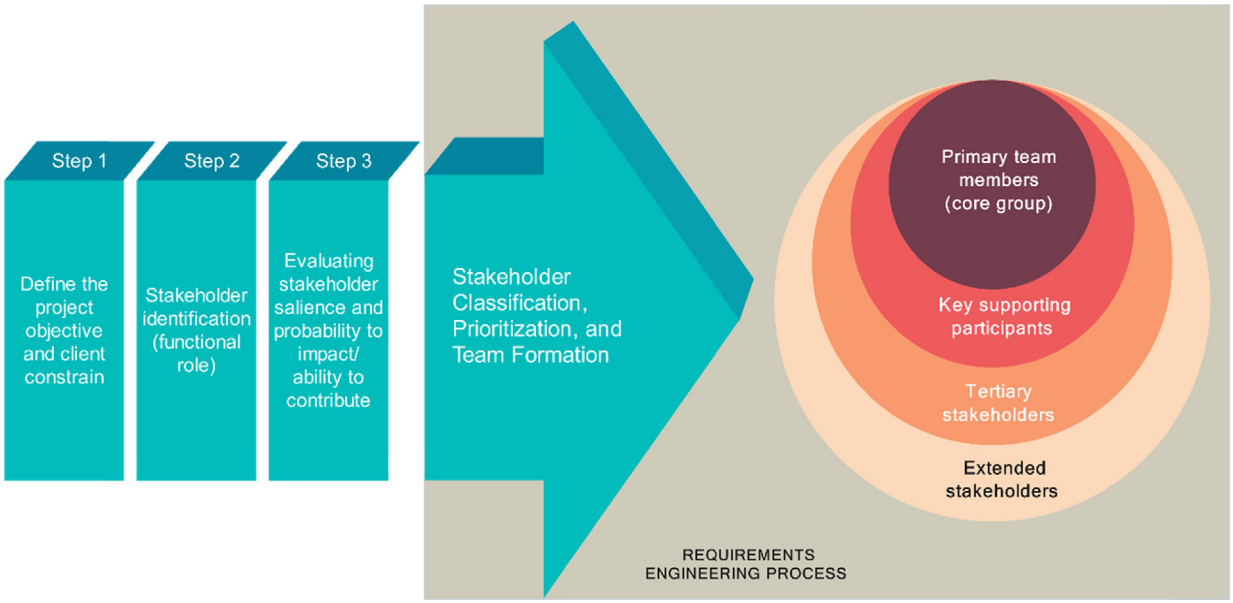

Fig. 1. Framework for SI and classification.

ware usability, in addition, to successfully use of technical support and user interaction (Almaiah et al., 2020; Almaiah & Alyoussef, 2019). Table 1 summarizes the factors that are affected by the SI process, which were identified from the previous work.

3. Research methodology

The purpose of this research is to identify the primary elements influenced by SI in an E-learning system. Fig. 2 depicts the research technique. The prior literature was thoroughly researched for variables affecting E-learning systems and SI issues, which determined the scope of this study and revealed the elements affecting SI. The literature review phase resulted in the development of motivation and objectives. Later on, the research question was developed. The survey was then designed to put to the test the most important and relevant elements found in literature. As a result of the survey, the factors influenced by stakeholder identification in e-learning systems have been highlighted in this paper.

Table 1
Factors affected by SI.

Factors	How factors can be affected by SI	Resources
Information quality	Improper SI results in stakeholders with a lack of skills, knowledge, and motivation which in turn leads to incompleteness, incompatibility, and inaccuracy in the information	(Al-Samarraie et al., 2018; Almaiah et al., 2020; Almaiah & Alyoussef, 2019; Naveed et al., 2017; Zhang, Cao, Shu, & Liu, 2020)
Development time and cost	Real stakeholders detect system errors from early stages which is save time and cost of development	(Burden & Kearney, 2016; Chituc, 2020)
System quality and usefulness	System quality and usefulness depend on the higher rate of reliability, consistency, stability, flexibility, documentation, and user's interaction and satisfaction which all depend on gathering data from appropriate stakeholders	(Al-Samarraie et al., 2018; Zhang et al., 2020)
Infrastructure and technology	The right use of hardware, software, technical supports, and user interaction required proper SI	(Al-Samarraie et al., 2018; Almaiah et al., 2020; Almaiah & Alyoussef, 2019; Naveed et al., 2017)

Table 1, factors affected by SI, was developed based on a deep analysis of the previous studies of the critical factors affecting the E-learning system and associated with the SI issue. To find out the significant factors influenced by SI in E-learning system the following qualitative research question was formulated:

RQ: What are the main factors that are affected by stakeholder identification in the E-learning system?

To answer the above research question, a survey questionnaire was constructed using Google Forms. Among the most popular methods used to scientifically explore the features and interrelationships among numerous variables is the survey approach. It has had a significant influence on a variety of study areas. Google form is an online free of cost platform that provides several services like developing survey forms, receiving and analyzing respondents' data. Most of the questions were formed as closed-end of type scaling questions. Closed-ended designs can provide summary information and minimize bias against the less literate or articulate. Moreover, respondents prefer closed questions that encourage respondents to do more work than open questions. The research followed the strategy of non-probability sampling which is a non-random practice as it depends on the objective and status of the research. The type of non-probability sampling applied in this research is the purposive sampling that is commonly used in this type of research. Purposive or judgmental sampling is a technique that focuses on the participants who can provide the required information and have the characteristics of great experience and knowledge in addition they can encourage related research. It is characteristically used in qualitative research (Etikan, Musa, & Alkassim, 2016).

Although there is no general agreement on the sample size for exploratory examinations, a sample size of 20 to 30 people is advised as a minimum. So, the sample of 35 meets the minimum required number for such a study (Morse, 2000). The total number of participants was 35, all from the field of E-learning such as the ministry of education, university, school, and training center. The

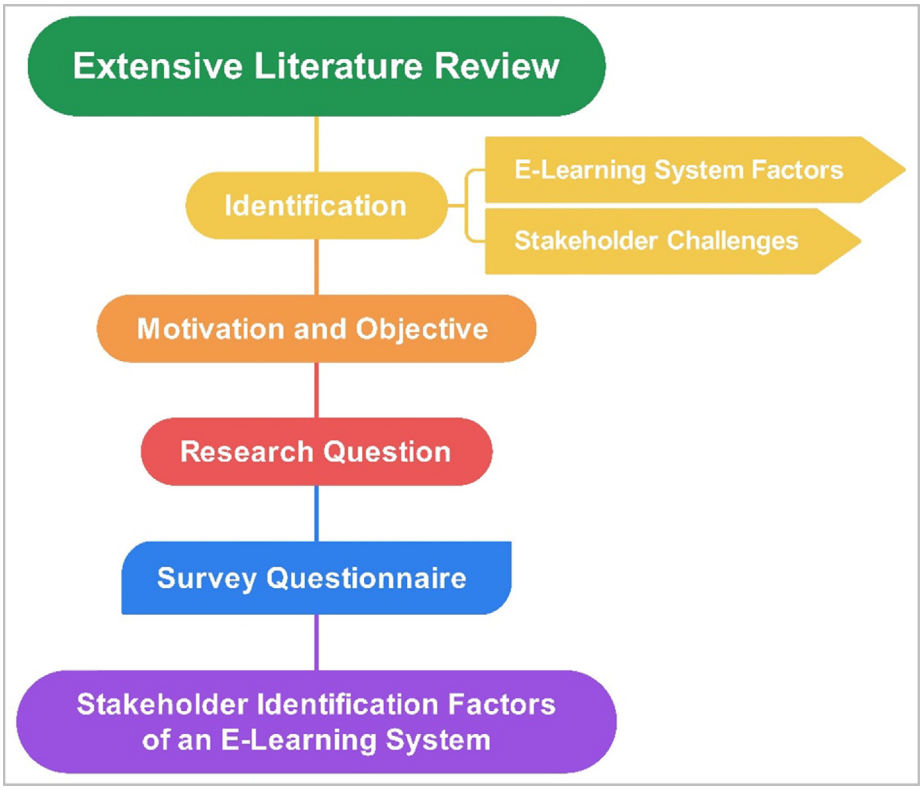

Fig. 2. Research methodology.

participants included 20 experts (has more than three years of experience in the field of E-learning), 7 analysts, and 8 developers. The mode of the E-learning system and the type of development used to build the E-learning system were taken into consideration. Table 2 displays the background of participants and the E-learning system in this study.

4. Data analysis

To answer the research question and address the factors affected by SI in the E-learning system, the responses of the participants were collected and categorized based on the related works and the survey questions. Table 3 represents how the survey questions are linked with the factors determined in the related works to approve their relationship with the SI issue.

Table 2
Background of participants and E-learning system.

Item	Categories	Number	Percentage
E-learning system organization	Ministry of education	5	14.3 %
	University	21	60 %
	School	5	14.3 %
	Training center	4	11.4 %
E-learning system mode	Synchronous	6	17.2 %
	Asynchronous	7	20 %
	Hybrid	22	62.8 %
Type of E-learning system development	Off-the-shelf	10	28.6 %
	Customized	18	51.4 %
	In house development	7	20 %
Participant role in the E-learning system	Experts	20	57.1 %
	Analysts	7	20 %
	Developers	8	22.9 %

5. Results

In this section, the results display the answer to the research question. This answer is found in detail in the study-related works and the responses of the questionnaire survey and then it is argued by the authors.

5.1. Descriptive analysis

Successful implementation of an E-learning system depends mainly on the actual involvement of all stakeholders. As per the previous studies and participants' responses, it has been proven that identifying the real stakeholders using an optimal method must be ensured the validity and completeness of the data, in addition to confirming the system's usefulness (Al-Ahmad & Kahtan, 2018b; Bednar & Winkler, 2020; Kahtan et al., 2022). Corroborative use of all system features and technologies creates a consistent and continuous system that is satisfying all users (Al-Ahmad & Kahtan, 2018a; Bednar & Winkler, 2020).

Fig. 3 displays the organization types, modes of an E-learning system, and participants' roles, which are mentioned in Table 2. Fig. 3 (organization types) shows four types of E-learning organisations that applied three modes of system development since the E-learning system has various types of stakeholders. Fig. 3 (E-learning system modes) presents the objectives of each learning organization, and the different characteristics and features in addition to the development modes (synchronous 17.2 %, asynchronous 20 %, and hybrid 62.8 %) show that there are different requirements for each organization. Therefore, each organization, based on the model of the development, needs to determine its own stakeholders to achieve the right and complete requirements, and satisfy users. Fig. 3 (participants' roles) presents the participants included in this survey, 20 experts (with more than three years of experience in the field of E-learning), 7 analysts, and 8 developers.

Table 3
Survey analysis.

Category	Survey questions	Clarification
Information quality	A scientific method was used to identify the stakeholders	Applying scientific methods in identifying stakeholders determines the accuracy of the data
	The data was collected from the right stakeholders	Proper SI real data collection
	You have good knowledge to identify stakeholders	Knowledge and skills lead to accurate and compatible data
	The methodology used to identify stakeholder	The extent of knowledge of scientific methods for identifying stakeholders
	You faced problems related to SI	Problems in identifying stakeholders produce incomplete and inaccurate data
Development time and cost	The type of development was used to build the E-learning system	The system development type (off-the-shelf, customized, in-home development) is based on stakeholder needs which has a key role in the system development time and cost
	The system development end time	System development end time early, on time, or late related to identifying stakeholders from early stages
	SI is the main reason for delaying system development	The extent of the impact of identifying stakeholders in the system development
System quality and usefulness	E-learning systems meet the staff and students needs	The extent to which the system meets the requirements of stakeholders (user satisfaction)
	There are noticeable deficiencies in the E-learning system	The size of the obstacles, whether they are large and cannot be overcome, or small, do not affect the system quality
	The system is flexible enough to accept the modification	The extent of the flexibility identifies whether the system is developed based on user requirements and capable of adding new features
	The system is running continuously and steadily	The extent of stability and continuity determines the system quality through quality requirements
Infrastructure and technology	E-learning systems' mode/type applied in your organization	Asynchronous mode: Learners can log on to an e-learning environment at any time; Synchronous mode: Instructors and learners meet online on a specific platform (Realtime); and Hybrid mode: A combination of both synchronous and asynchronous. Each mode has different technologies, therefore, different stakeholders and requirements
	System IoT technologies are activated and working efficiently	Determine task technology fit and activation based on identifying proper stakeholder
	The activation of IoT technologies with the appropriate SI	

5.2. Factors that affected by stakeholder identification in the E-learning system

Four effective factors affected by SI in the E-learning system are nominated and approved depending upon the questionnaire survey participants' responses which are: Information quality, development time and cost, system quality and usefulness, and infrastructure and technology.

5.2.1. Information quality

Information quality is considered as the most critical factor that influences the E-learning system since it is strongly relevant to what the stakeholders are required therefore, the first process should be conducted to identify the proper stakeholders to collect the accurate requirements. Different methods can be used to identify various stakeholders. Fig. 4 (Using method for SI) displays 25.7 % of respondents have not used the SI method and 34.3 % of them were neutral in response to using the SI method. On the other hand, 40 % of respondents have used the scientific method for identifying the system stakeholders. Utilizing the scientific method is a critical factor in the proper implementation of SI which ensures the system information quality is the main influencer of user satisfaction. Fig. 4 (Collecting data from right stakeholders) shows that 20 % of respondents have not collected the data from the right stakeholders. It also shows that 57.2 % of participants have collected the data from the right stakeholders but the remaining 22.8 % were undecided about whether they collected the data from the right stakeholder or not. The right stakeholders have a profound impact on the requirements, which in turn ensures the quality of the information. The presence of a problem in collecting data from the real stakeholders will certainly lead soon to the instability and ineffectiveness of the system.

Fig. 4 (Problems related to SI) clarifies 40 % of respondents encountered difficulties in identifying stakeholders and 28.6 % of the respondents did not indicate that they had difficulties in identifying stakeholders or not. On the other hand, 31.4 % declared that they have not faced any problem in identifying stakeholders. The obstacle in identifying the stakeholder may lead to omitting some stakeholders which will lead to incomplete or hidden requirements. Fig. 4 (SI knowledge) illustrates the percentage of SI knowledge, 31.4 % of respondents have neutral answers. Furthermore, 62.8 % of participants confirmed their knowledge, while 5.8 % was recorded for those who did not know the subject definition of stakeholders. Analysis of the results showed that there are complications related to the SI, and a large proportion of the respondents are not fully aware of this matter, despite their urgent need for it, which in turn will directly affect the quality of information through incomplete and inaccurate data.

5.2.2. Development time and cost

Cutting development time and cost is one of the significant competitive factors that every development company takes into consideration. Fig. 5 (E-learning system development type) exhibits three types of E-learning system development affecting time and cost. The pie chart shows half of the participants built customized software, a quarter of them applied off-the-shelf software, and the other quarter developed in-house software. Although off-the-shelf software may save time and cost, it often does not meet all the user requirements and is not easy to modify because it is not constructed based on the real stakeholder's needs and this greatly affects the quality of the system.

Fig. 5 (System development end time) presents 20 % of the participants who completed their system development before the deadline and the high percentage (48.6 %) was recorded for those who completed the project timeline on time, while the percentage of those who failed to complete developing their projects on time (late) is (31.4 %). The identification of the real stakeholders is one of the most important factors playing the main role in this delay.

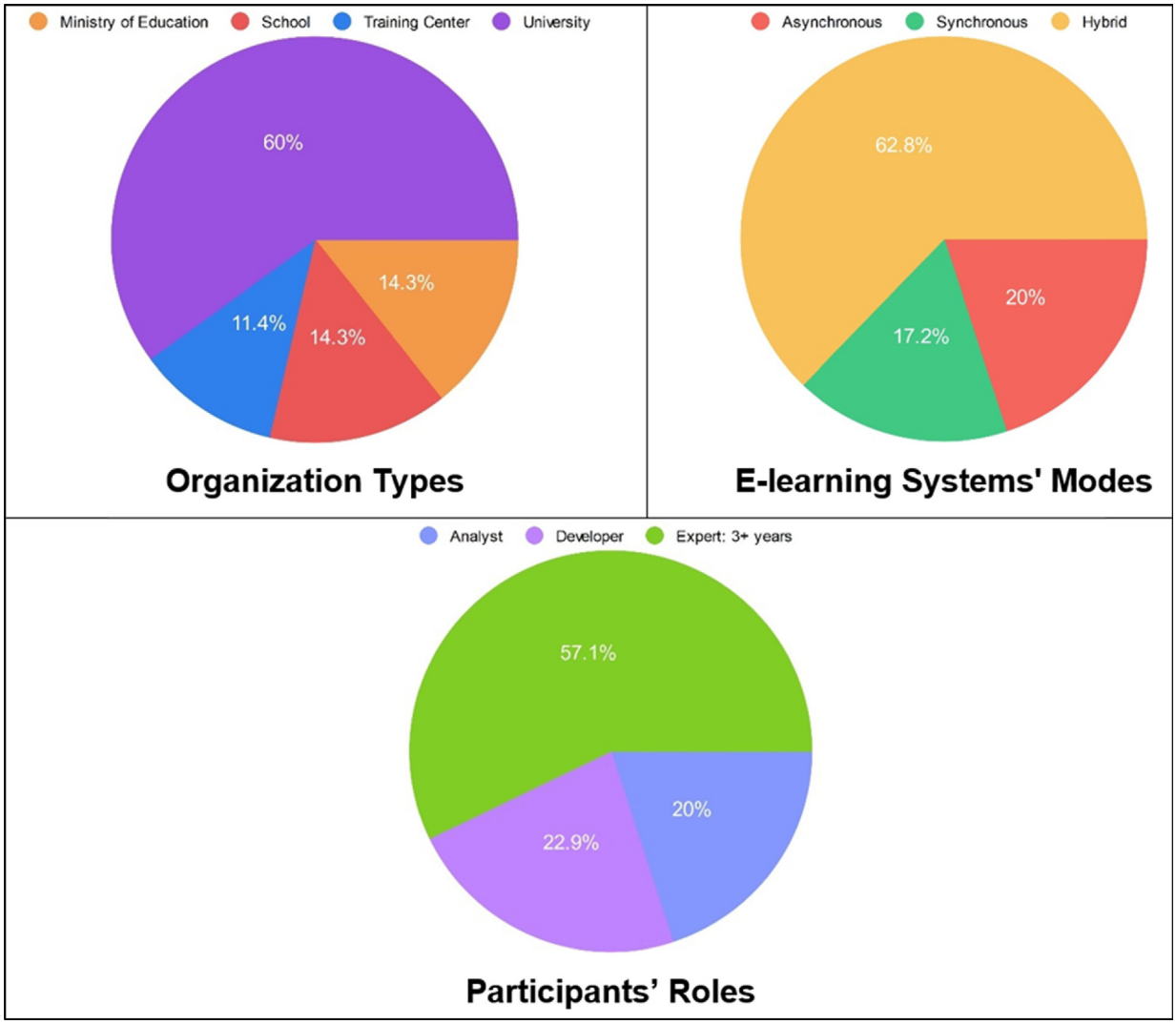

Fig. 3. Organization Types/E-learning System Modes/Participants' Roles.

Fig. 5 (SI reason of delaying system development) confirmed that SI influences the system development time and cost, as the largest proportion (45.7 %) of the participants agreed on that and 22.9 % give a neutral answer, on the other hand, 31.4 % disagreed with that. Timeline is considered as an essential aspect that affects the system quality. The main element of the timeline is a stakeholder and if identified properly this will save time and cost.

5.2.3. System quality and usefulness

User satisfaction is a part of system quality factors (Al-bashiri et al., 2019; Al-Fraihat et al., 2020). Learners and instructors are considered fundamental stakeholders of the E-learning system, therefore; they should be satisfied through meeting their requirements. Identifying the right learner and instructor will ensure system usefulness. Fig. 6 (System meets user needs) illustrates that 2.9 % of participants believe that the system does not meet the requirements which means that there is a problem in collecting the required data from the right stakeholders. In addition, 20 % of the participants did not respond that the system met their requirements or not. While there are 77.1 % who stated that the system met their needs and satisfied them, which shows that the requirements were collected correctly and from the real stakeholders, therefore, ensuring the quality of the requirements and the efficient functioning of the system requires understanding stakeholder needs correctly, and to obtain the correct understanding, the stakeholder with high knowledge and skills must be defined.

Fig. 6 (system continuity and stability) shows that 74.3 % of the participants agreed to the stability and continuity of their systems which is a high percentage, this means that they are satisfied with the system functionality. As for the respondent who did not agree to the continuity of the system, this means there is a problem related to fulfilling the system requirements through the right stakeholder, which causes dissatisfaction. The graph in Fig. 6 (system flexibility) shows that 20 % of respondents confirm the inflexibility of the system, 57.2 % satisfied with the flexibility of the systems, and 22.8 % answered with a neutral. Flexibility is an indication of the correct design and implementation of the system, which depends largely on how the requirements are provided by stakeholders. Fig. 6 (system deficiencies) shows that 34.3 % of participants have deficiencies in the system and 11.4 % did not specify if there were deficiencies or not, while more than half confirmed that there are no shortages that faced their E-learning systems and this matter directly or indirectly related to the stakeholder, as it is a main source of requirements and therefore it can be said

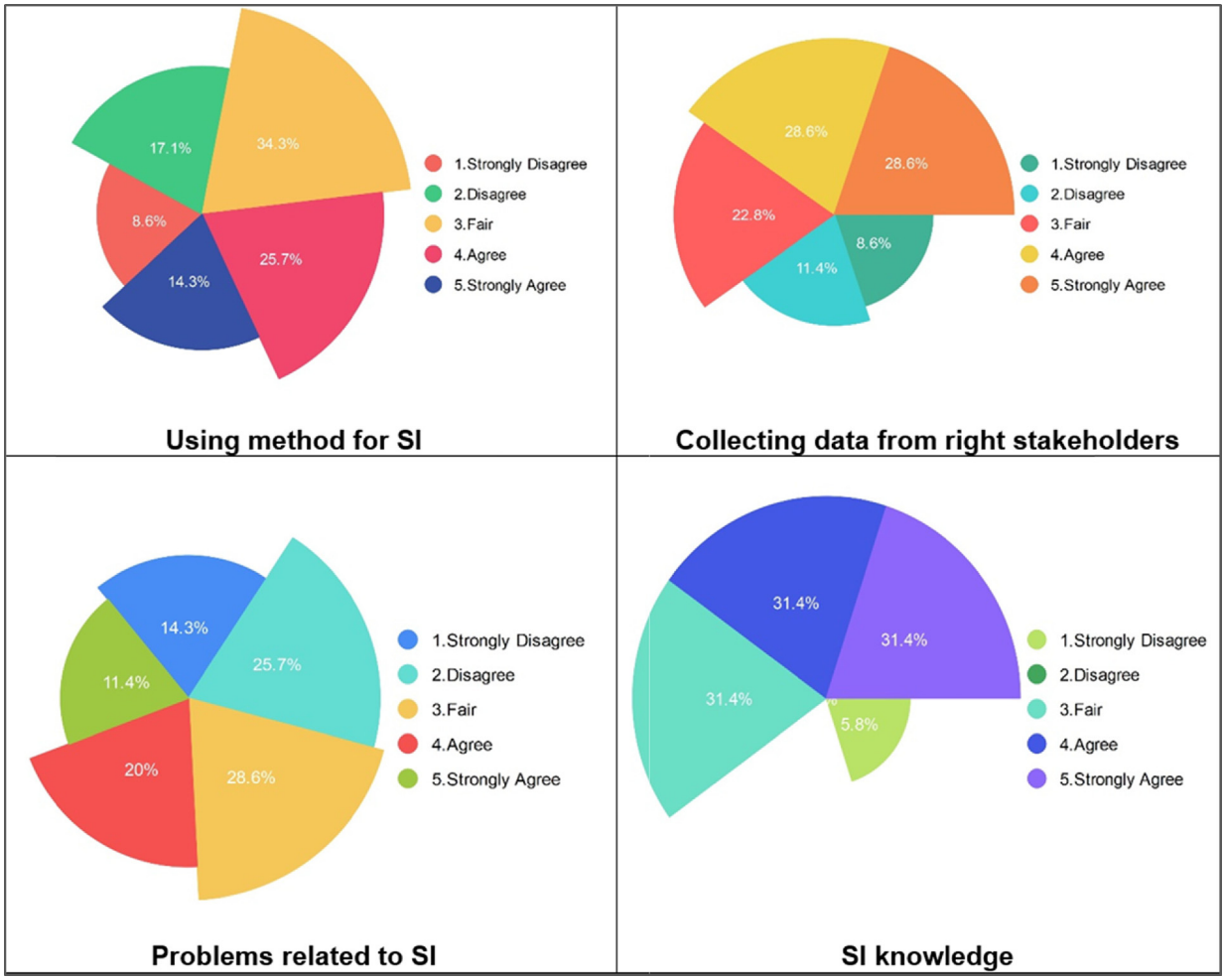

Fig. 4. Using method for SI/Collecting data from right stakeholders/Problems related to SI/SI knowledge.

that all the previous elements, namely: user satisfaction, system flexibility, and system continuity and sustainability are due to the same reason.

5.2.4. Infrastructure and technology

Technology fit is one of the user satisfactions factors, and if a question is asked how to satisfy the main E-learning system stakeholders (learner, instructor) by this factor? The answer will be by the high level of efficiency of using these technologies by them. Internet of Things (IoT) is one of the fundamental technologies that influence E-learning systems promoted with different components. Utilizing IoT in E-learning systems provides an interactive and smart platform for students and instructors and enhances the learning process. Fig. 7 (system IoT technology activation) elucidates that 17.2 % of participants disagree that E-learning system IoT technology is activated and working properly and 45.7 % have a neutral answer as 37.1 % agree on the efficiency of system technology activation.

Fig. 7 (relation of IoT technology activation with SI) illustrates that more than half of participants approve that inactivation and improper use of their E-learning system IoT technologies are related to inaccurate SI and 28.6 % of their answer is neutral while there is 20 % disagree to assign the problem of IoT technology activation to the SI. E-learning systems are among the systems that depend entirely on technologies, which are the life of the system, and therefore its effectiveness must be ensured the extent to which stakeholders need and use these technologies speedily and easily by referring to the real stakeholders (knowledgeable students and lecturers).

6. Discussion

The purpose of this article is to respond to the research question: the primary aspects influenced by SI. The findings of this work have important implications for E-learning practitioners and researchers. This was accomplished by a poll of 35 professonals from educational institutions, ministries of education, and developers. This work, like any other empirical study, has some consequences, limits, and future difficulties, which are described in the parts that follow.

6.1. Implications for research and practice

This research offers crucial theoretical and practical insights into how E-learning systems are used and adopted. This study adds to the current literature by outlining the key obstacles caused by SI concerns. The most significant components of SI issues have been recognized i.e., information quality, time and cost, system utility, and technology. The results of this paper provide important recommendations for academics, developers, and regulators, allowing them to better understand the critical factors of effective E-learning system implementation. This research has immediate

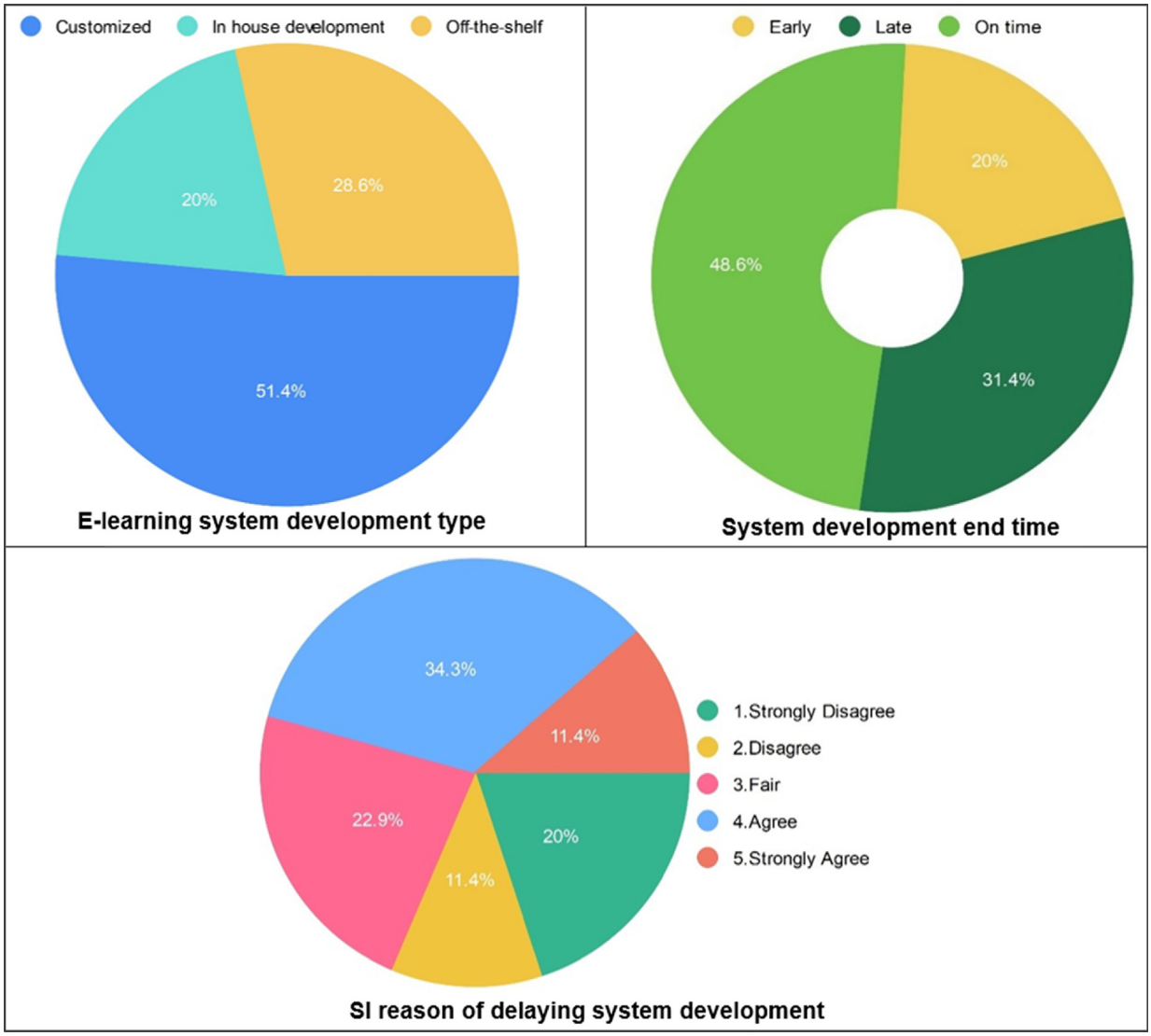

Fig. 5. E-learning system development type/System development end time/SI reason of delaying system development.

ramifications for technology-assisted learning. As digital assistants grow more common and intelligent, they will be able to collaborate with active learning methods to give students more personalized learning experiences. It will also enable instructors and administrators to have a far better insight into their students' comprehension of complicated subjects and themes.

Educational ministries may develop new laws and regulations to encourage teachers and learners to use E-learning systems. They may also need to make certain modifications to educational policies to guarantee that the transition from conventional to E-learning is as smooth as possible. Training courses, leadership support, and teachers adhering to institution norms for using the E-learning system in the teaching process can all help to bring about these improvements. All this may lead to enhanced information quality. Since adequate access to E-learning materials without any technical problems or delays is highly related to raising the acceptance of E-learning systems successfully, support services and institutions must provide the required resources and continuous maintenance for E-learning systems. This includes all different resources such as network requirements, software, and hardware. Furthermore, usability and ease of use are two crucial factors that policymakers and designers of E-learning systems should pay close attention to. This is especially true because most students and teachers are unfamiliar with such a system, and if it is not easy to use and helpful, adoption and success are unlikely.

In future work, we recommend exposing the correct method for identifying E-learning system stakeholders which provide standard guidance and facilitate the proper development of the E-learning system. To ensure user satisfaction, selecting appropriate SI evaluation methods for the E-learning system is one of the essential recommendations that should find great interest from researchers. This research motivates researchers to detect new methods for identifying stakeholders for various and multiple projects and evaluating them.

6.2. Limitations

This work, like any other empirical study, has several limits that must be addressed when considering its conclusions. The limitations of this research relate to the possibility of not including all references of this aspect because of not dependent on all research sources, as well as its reliance on the latest previous studies, which necessitates considering this issue, but this does not preclude the complete reliance on this research in the future studies. Moreover, we sent a survey form to reduce the issue of subjectivity. Based on the study's aims and existing research findings, this survey was

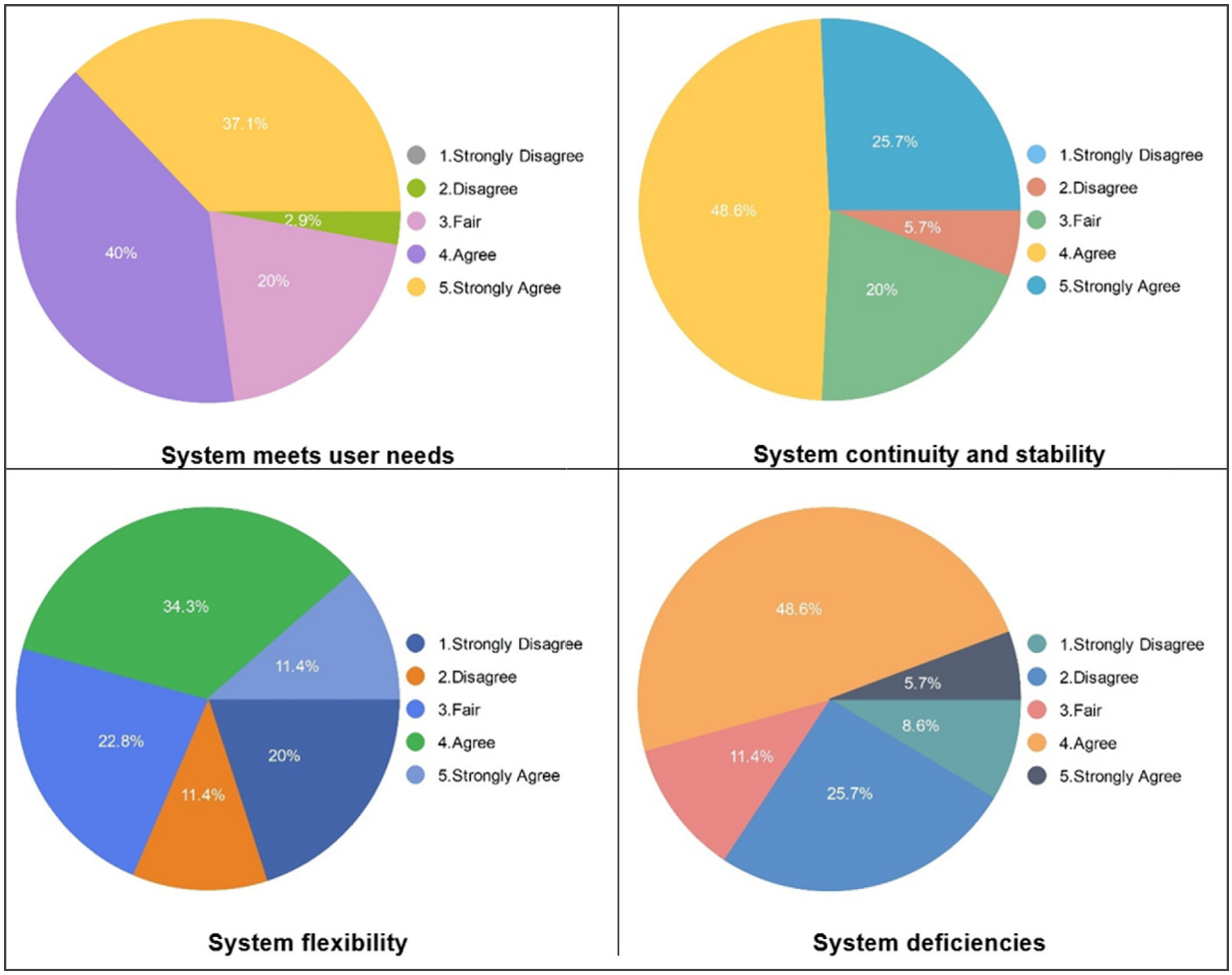

Fig. 6. System meets user needs/System continuity and stability/System flexibility/System deficiencies.

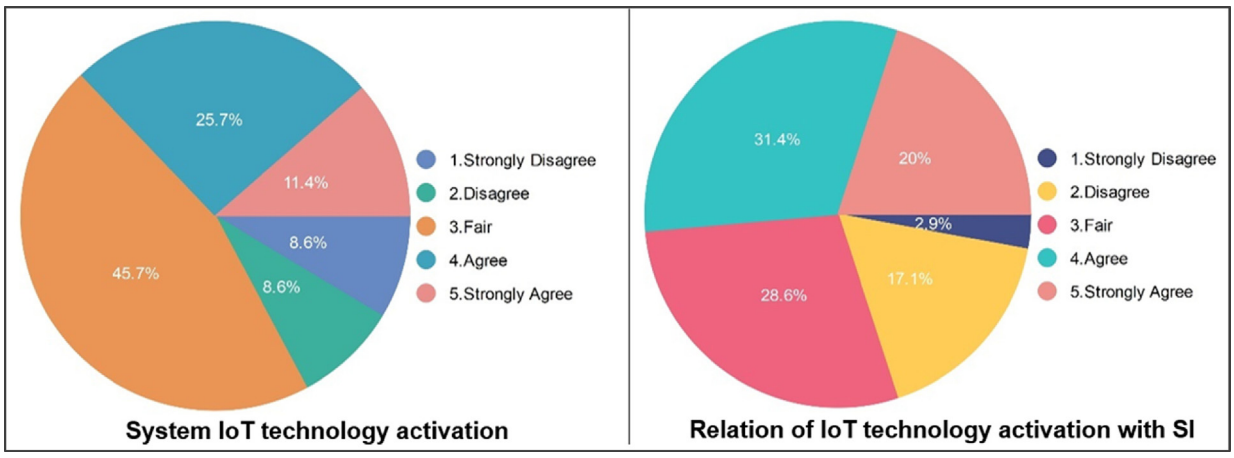

Fig. 7. System IoT technology activation/Relation of IoT technology activation with SI.

created. Another limitation of this study could be its small sample size and specificity, as the targeted participants are focus groups of experts in the field of E-learning to gain detailed knowledge, and it is difficult to access many experts in this field. Furthermore, the sensitivity of the E-learning system necessitates careful collection of information from specialists to reach convincing results. According to several authors (e.g., (Louangrath, 2017; Morse, 2000)), 35 participants are enough for such a study

6.3. Future challenges

Here, we discuss the future challenges that will affect and should be addressed in the context of the SI issue.

6.3.1. Personal considerations

Personal factors are related to the personnel of the stakeholders (e.g., learners and instructors). The teacher facilitates the transmis-

sion of information by identifying high-quality learning resources, instructional goals, and evaluation techniques (Al Kurdi et al., 2020; Salehudin et al., 2019). Teachers must also have computer abilities because they are the cornerstone of the E-learning system's activities. Teachers may be hesitant to accept E-learning because they fear their existing position may be jeopardized. To assist mitigate this reluctance, teachers should be educated about the benefits and necessity of E-learning in today's world through courses and seminars. Misapplication causes a learner's bewilderment and drives them to wane. On the other hand, the learner is one of the most important participants in the E-learning system. Learners are actively engaged in the E-learning system's learner-centered approach, resulting in more efficient learning. The Internet is necessary, and it necessitates some computer skills and maintenance. However, acquiring such expertise may be expensive and time-consuming (Al Kurdi et al., 2020; Salehudin et al., 2019).

Skills are parts of the educational society's skill in conducting E-learning that may be developed via repeated usage of E-learning technologies in the learning process. To engage in E-learning, both teachers and students must have computer skills. Students who lack basic computer skills may suffer fear and would be unable to reap the benefits of E-learning. Teachers must also have computer skills because they are at the heart of all tasks in such a system. Learners who are more adaptable with E-learning are more likely to have a favorable attitude toward it, be involved in it, and therefore succeed and enhance their E-learning experience. Another criterion for E-learning deployment is having a sufficient understanding and knowledge about the E-learning process. Teachers' lack of understanding of the practice of adopting the E-learning process leads to a reduced capacity to comprehend the E-learning application system. Moreover, knowledge management (a set of abilities that allows a person to assess their own information demands) is a learner-related aspect. It assists students in developing search algorithms by finding and assessing available data in order to produce new data. Furthermore, the sociocultural characteristic, which describes society or community attitudes toward E-learning systems adoption, is another criterion that impacts SI. Given its growing popularity, it is vital to promote E-learning first among academics and then among the general population. People may foster a more favorable attitude toward E-learning by spreading awareness of its features, goals, and benefits, so encouraging users to become more enthusiastic and active in this environment (Al Kurdi et al., 2020; Salehudin et al., 2019).

6.3.2. Organizational culture

Organizational culture is defined as a collection of concepts, values, ideas, or standards that are relevant, agreed upon, and followed by people in an organization as guidance for conduct and problem resolution (Alzoubi et al., 2013). The biggest value in assuring the success of E-learning is cultural support (Priatna et al., 2020). Executive managers must approve E-learning because they must grasp how it may save costs and increase income, increase the quality of the product, and boost employee performance. Managers may make a difference in their businesses by enhancing and simplifying transformation. When a company wishes to increase the efficiency of a process, it has to develop an executive strategy. Management support is focused on the online resources and assistance required to create relevant learning settings. It is critical for every company interested in E-learning to establish the student and teacher's responsibilities, offer reasons for E-learning, and provide educational assistance. Scientific, technological, and counseling support should be given to assist E-learning programs (Priatna et al., 2020).

6.3.3. Emerging technologies

Technology is the knowledge that is utilized practically and methodically to suit human requirements (Hasan et al., 2017; Kummar et al., 2019). All procedures that are carried out in an attempt to materialize something logically are classified as technology (Al-Ahmad et al., 2019). In the scope of adopting E-learning, technological elements such as usefulness, dependability, completeness, and accessibility are taken into account. E-learning must be supported in terms of software, hardware, and new developing technologies like the IoT, Cloud computing, edge computing, Augmented Reality (AR), Artificial Intelligence (AI), and Quantum computing (Alzoubi et al., 2021a). All of these innovations will have a significant impact on E-learning. Therefore, lack of any of these technologies awareness will have a negative impact on SI and as a result, will negatively affect E-learning process efficiency (Alzoubi et al., 2021a).

The IoT has been defined as a concept that encompasses a wide range of applications built on the confluence of smart items and the Internet, allowing for seamless integration of the real and virtual worlds. It allows electronics and the physical world to communicate seamlessly. As a result, IoT technology may be used in E-learning, where IoT can help with social distance. Increasing public concerns regarding the use and exploitation of personal data in IoT will remain at the forefront of future discussions concerning the ethical development and use of AI in educational systems. Moreover, Concerns about IoT users' security and privacy are still a major worry (Alzoubi et al., 2021b).

In contrast to natural intelligence, which is proven by animals and human animals, AI is typically characterized as machine intelligence exhibited by a non-living object. This new technology revolution is expected to result in a surge in technical progress. By the year 2050, 50 % of major AI experts anticipate that AI will attain general (or robust) intelligence, while 90 % estimate that general AI will be achieved by 2070 (Leahy et al., 2019). The advancement of AI has the power to reshape the learner-technology connection. It will enable expert machines to deduce an unparalleled degree of individual information from pupils, allowing them to give highly tailored real-time learning processes, treatments, and evaluations. There are several warning models about AI breakthroughs and their influence on educational systems. One of the warning signs highlighted is the possibility for the learner-teacher connection to be transformed and, if not done correctly, weakened. The latest hypothetical situation showed that students became alienated from their lecturers as the teacher were more on guidance instead of direct communication, to the point where the relationship all but disappeared (Leahy et al., 2019).

AR is a technique that lets virtual things be superimposed on the actual environment using a mix of lens and display technologies. Unlike virtual reality, where the user is entirely engaged in the virtual space and has no sense of the actual world, AR takes the real world as its source and overlays virtual things so that the real and virtual worlds seem to the user as one. Education benefits and inspiration, pleasure, giving opportunities for interaction and cooperation, and favorable attitudes toward the learning program were the key demonstrated benefits of AR in educational contexts. However, AR has several limitations including mapping, material arrangement, lack of better resolution, and positional monitoring. Another major barrier to AR adoption in education is the scarcity of an educational platform that allows teachers to build custom contextual experiences for their students, as well as the need to devote significant time to researching the pedagogical value of AR and planning activities that incorporate AR effectively (Alzoubi et al., 2022).

Quantum computing is another technology that may shape the future of E-learning and SI in the future. It promises extraordinarily efficient methods, allowing for exponential speedups of some technically significant tasks. Despite the fact that only modest quantum processors are now accessible, there are high hopes for this technology, owing to the common assumption that quantum computing would increase at an exponential pace in the near future (Orus et al., 2019). Although quantum computing promotes technical advancement and growth, it will jeopardize the present and future growth of emerging technologies such as AI and IoT (Kanimozhi et al., 2019). This is owing to its capacity to do infinitely complicated computations in parallel, making it easier and faster to defeat security techniques used to secure these emerging technologies (Abuarqoub, 2020).

6.3.4. Regulations

The rules and policies are a set of strategies, measures, actions, and choices to operate or not act made by the stakeholders as part of the problem-solving process. The usage of digital devices must be controlled by laws established by academic institutes as a requirement inherent in the educational society's primary activities and functions (AlAhmad et al., 2021). Institutions must invest appropriate resources to ensure that E-learning deployment runs smoothly in order to sustain the efficacy of these requirements (Priatna et al., 2020; Kahtan et al., 2012). If the E-learning system lacks the necessary academic regulations, developers and instructors may choose tactics that are more appropriate for conventional education systems. As a result, E-learning may be as easy as scrolling through online sites and filling in e-mail boxes, or it can be as complex as giving simple alternates to classroom-based learning. Educational design in E-learning may have a significant impact on SI and academic achievement. Moreover, one of the most crucial requirements is the creation of e-content, which could be the biggest barrier and impediment to the growth of E-learning in some countries (Leahy et al., 2019).

7. Conclusion

SI in an E-learning system is a requirement engineering approach that needs to be considered since it has an important impact on the success of the learning process. The instability of the E-learning system and the complications that arise continuously encourage this research. Based on a deeper analysis of previous studies of E-learning system factors and SI challenges, in addition to the questionnaire survey technique using purposive sampling of 35 respondents in the E-learning field, this study contributes to improving the requirement engineering process by investigating the problems of identifying the appropriate stakeholder in an E-learning system and how this process is important for such a type of system. The paper did so by addressing four main issues influenced by SI in E-learning: information quality, development time and cost, system quality and usefulness, and infrastructure and technology.

In addition, the results reported in this paper demonstrated that there are difficulties in defining the actual stakeholders, as well as a lack of knowledge in employing the appropriate techniques to identify them, which were then analyzed and compared to generate the list of factors. The factors identified in this paper help industries understand how critical it is to identify the actual stakeholders of an E-learning system at an early stage. Therefore, industries should be able to develop the E-learning system in a way that is stable and reliable.

It's critical to recognize that the advances discussed in this article are susceptible to shifting and changing due to a variety of factors, including but not limited to human traits, corporate culture, evolving technology, and legislation. E-learning perceived conceptions assume that institutions, duties, and regulations may stay unchanged within the system, even though it is feasible to reject the expected and inevitable future and envision a world outside of the scope of the industrialized vision of the future. Therefore, future studies must seek to encourage further thinking that perceives the new digital technologies and components in education as part of a larger set of factors affecting people's well-being, and that deems learning opportunities throughout official and non-official settings by linking class learning with families and communities.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jksus.2023.102566.

References

Al Kurdi, B., Alshurideh, M., Salloum, S.A., 2020. Investigating a theoretical framework for e-learning technology acceptance. Int. J. Electrical Computer Eng. (IJECE) 10 (6), 6484–6496. https://doi.org/10.11591/ijece.v10i6.pp6484-6496.

AlAhmad, A.S., Kahtan, H., Alzoubi, Y.I., Ali, O., Jaradat, A., 2021. Mobile cloud computing models security issues: a systematic review. J. Network Computer Applications 190 (2021). https://doi.org/10.1016/j.jnca.2021.103152. 1-17.

Kahtan, H., Bakar, N.A. and Nordin, R., 2012. Reviewing the challenges of security features in component based software development models. In: Paper presented at the IEEE Symposium on E-Learning, E-Management and E-Services (IS3e), 2012, Kuala Lumpur. https://doi.org/10.1109/IS3e.2012.6414955

Abuarqoub, A., 2020. Security Challenges Posed by Quantum Computing on Emerging Technologies. In: Paper presented at the Proceedings of the 4th International Conference on Future Networks and Distributed Systems (ICFNDS). https://doi.org/10.1145/3440749.3442651

Al-Ahmad, A.S., Kahtan, H., 2018a. Cloud Computing Review: Features And Issues. In: Paper presented at the 2018 International Conference on Smart Computing and Electronic Enterprise (ICSCEE), Kuala Lumpur. https://doi.org/10.1109/ICSCEE.2018.8538387

Al-Ahmad, A.S., Kahtan, H., 2018b. Fuzz test case generation for penetration testing in mobile cloud computing applications. In: Paper presented at the International Conference on Intelligent Computing & Optimization. https://doi.org/10.1007/978-3-030-00979-3_27

Al-Ahmad, A.S., Kahtan, H., Hujainah, F., Jalab, H.A., 2019. Systematic literature review on penetration testing for mobile cloud computing applications. IEEE Access 7, 173524–173540. https://doi.org/10.1109/ACCESS.2019.2956770.

Al-bashiri, H., Kahtan, H., Abdulgabber, M.A., Romli, A., Fakhreldin, M.A.I., 2019. Memory-based collaborative filtering: impacting of common items on the quality of recommendation. Int. J. Adv. Computer Sci. Applications 10 (12). https://doi.org/10.14569/IJACSA.2019.0101218.

Al-Fraihat, D., Joy, M., Sinclair, J., 2020. Evaluating E-learning systems success: an empirical study. Comput. Hum. Behav. 102, 67–86. https://doi.org/10.1016/j.chb.2019.08.004.

Almaiah, M.A., Alismaiel, O.A., 2019. Examination of factors influencing the use of mobile learning system: an empirical study. Educ. Inf. Technol. 24 (1), 885–909. https://doi.org/10.1007/s10639-018-9810-7.

Almaiah, M.A., Alyoussef, I.Y., 2019. Analysis of the effect of course design, course content support, course assessment and instructor characteristics on the actual use of E-learning system. IEEE Access 7, 171907–171922. https://doi.org/10.1109/ACCESS.2019.2956349.

Almaiah, M.A., Al-Khasawneh, A., Althunibat, A., 2020. Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. Educ. Inf. Technol. 25, 5261–5280. https://doi.org/10.1007/s10639-020-10219-y.

Al-Samarraie, H., Teng, B.K., Alzahrani, A.I., Alalwan, N., 2018. E-learning continuance satisfaction in higher education: a unified perspective from instructors and students. Stud. High. Educ. 43 (11), 2003–2019. https://doi.org/10.1080/03075079.2017.1298088.

Alzoubi, Y.I., Al-Ahmad, A., Kahtan, H., 2021a. Blockchain technology as a Fog computing security and privacy solution: an overview. Comput. Commun. 182, 129–152. https://doi.org/10.1016/j.comcom.2021.11.005.

Alzoubi, Y.I., Al-Ahmad, A., Kahtan, H., Jaradat, A., 2022. Internet of things and blockchain integration: security, privacy, technical, and design challenges. Future Internet 14 (7), 216. https://doi.org/10.3390/fi14070216.

Alzoubi, Y., Kang, K., Aljaafreh, A., 2013. Socio-Organisational Approach to Online Banking Transaction Risk Communication inside Banks in Jordan. In: Paper presented at the Proceedings of the eChallenges 2013, Malahide, County Dublin, Ireland.

Alzoubi, Y.I., Osmanaj, V.H., Jaradat, A., Al-Ahmad, A., 2021b. Fog computing security and privacy for the Internet of Thing applications: State-of-the-art. Security Privacy 4 (2), e145. https://doi.org/10.1002/spy2.145.

Bednar, K., Winkler, T.J., 2020. Ontologies and Knowledge Bases: A New Way to Represent and Communicate Values in Technology Design. In: Paper presented at the Societal Challenges in the Smart Society.

Bentrad, S., Kahtan Khalaf, H., Meslati, D., 2020. Towards a hybrid approach to build aspect-oriented programs. IAENG Int. J. Comput. Sci. 47 (4) http://www.iaeng.org/IJCS/issues_v47/issue_4/IJCS_47_4_08.pdf.

Burden, K., Kearney, M., 2016. Future scenarios for mobile science learning. Res. Sci. Educ. 46 (2), 287–308.

Chituc, C.-M., 2020. Interoperability Standards in the IoT-enabled Future Learning Environments: An analysis of the challenges for seamless communication. In: Paper presented at the Proceedings of the 13th International Conference on Communications (COMM), Bucharest, Romania.

Dodero, J.M., González-Conejero, E.J., Gutiérrez-Herrera, G., Peinado, S., Tocino, J.T., Ruiz-Rube, I., 2017. Trade-off between interoperability and data collection performance when designing an architecture for learning analytics. Futur. Gener. Comput. Syst. 68, 31–37.

Ekuase-Anwansedo, A., Craig, S.F., Noguera, J., 2018. How to Survive a Learning Management System (LMS) Implementation? A Stakeholder Analysis Approach. In: Paper presented at the Proceedings of the 2018 ACM SIGUCCS Annual Conference.

Elneel, D.A., Fakharudin, A.S., Ahmed, E.M., Kahtan, H., Abdullateef, M., 2022. Stakeholder Identification Overview and Challenges in Requirements Engineering Prospective. In: Paper presented at the 2022 2nd International Conference on Computing and Information Technology (ICCIT). https://doi.org/10.1109/ICCIT52419.2022.9711653

Etikan, I., Musa, S.A., Alkassim, R.S., 2016. Comparison of convenience sampling and purposive sampling. Am. J. Theor. Appl. Stat. 5 (1), 1–4.

Fritz, M.M., Rauter, R., Baumgartner, R.J., Dentchev, N., 2018. A supply chain perspective of stakeholder identification as a tool for responsible policy and decision-making. Environ. Sci. Policy 81, 63–76.

Hasan, K., Suryanti, A., Maath, S., Shahirah, T.S., Shamsuri, T., 2017. Motion analysis-based application for enhancing physical education. Adv. Sci. Lett. 24 (10), 7668–7674. https://doi.org/10.1166/asl.2018.12997.

Kahtan, H., Abdulhak, M., Al-Ahmad, A.S., Alzoubi, Y.I., 2022. A model for developing dependable systems using a component-based software development approach (MDDS-CBSD). IET Softw. 1–17. https://doi.org/10.1049/sfw2.12085.

Kanimozhi, S., Kannan, A., Suganya Devi, K., Selvamani, K., 2019. Secure cloud-based e-learning system with access control and group key mechanism. Concurrency Computation: Pract. Experience 31 (12), e4841.

Kummar, S., Al-Aani, F.S., Kahtan, H., Darr, M.J., Al-Bashiri, H., 2019. Data visualisation for smart farming using mobile application. Int. J. Computer Sci. Netw. Security 19 (11), 1–7 http://paper.ijcsns.org/07_book/201911/20191101.pdf.

Leahy, S.M., Holland, C., Ward, F., 2019. The digital frontier: Envisioning future technologies impact on the classroom. Futures 113, 102422.

Louangrath, P., 2017. Minimum sample size method based on survey scales. Int. J. Research Methodol. Social Sci. 3 (2), 44–52.

Martin, S., 2021. Teaching and Learning Advances on Sensors for IoT. In: MDPI.

Morse, J.M., 2000. Determining sample size. In, Vol. 10. Sage Publications Sage CA:, Thousand Oaks, CA, pp. 3–5.

Naveed, Q.N., Muhammed, A., Sanober, S., Qureshi, M.R.N., Shah, A., 2017. Barriers effecting successful implementation of E-Learning in Saudi Arabian universities. Int. J. Emerg. Technol. Learn. 12 (6), 94–107.

Orus, R., Mugel, S., Lizaso, E., 2019. Quantum computing for finance: overview and prospects. Rev. Phys. 4, 100028–100040. https://doi.org/10.1016/j.revip.2019.100028.

Priatna, T., Maylawati, D., Sugilar, H., Ramdhani, M., 2020. Key success factors of e-learning implementation in higher education. Int. J. Emerging Technologies Learning (iJET) 15 (17), 101–114.

Salehudin, N.B., Kahtan, H., Al-bashiri, H., Abdulgabber, M.A., 2019. A proposed course recommender model based on collaborative filtering for course registration. Int. J. Adv. Computer Sci. Applications, (IJACSA) 10 (11), 162–168. https://doi.org/10.14569/IJACSA.2019.0101122.

Zaguia, A., Ameyed, D., Haddar, M., Cheikhrouhou, O., Hamam, H., 2021. Cognitive IoT-Based e-Learning system: enabling context-aware remote schooling during the pandemic. J. Healthcare Eng.

Zhang, Z., Cao, T., Shu, J., Liu, H., 2020. Identifying key factors affecting college students' adoption of the e-learning system in mandatory blended learning environments. Interact. Learn. Environ., 1–14