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# Adoption of SPACE-learning management system in education era 4.0: an extended technology acceptance model with self-efficacy

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The COVID-19 pandemic has caused constraints on education that takes place face-to-face; thus, the learning process has been conducted online. With this emergence, an application-based learning tool called a Learning Management System (LMS) was created to cater to the requirements of distant students. Therefore, this study explores how SPACE-LMS is used in the Teacher Professional Education Program (TPEP) and how it interacts with the Technology Acceptance Model (TAM) and self-efficacy. This study collected data from TPEP participants in the province of West Sumatra-Indonesia from the 2022 cohort, and 245 individuals actively participated. As the quantitative method, Partial Least Square-Structural Equation Modeling (PLS-SEM) analysis with SmartPLS software was used to test and predict the conceptual model. The empirical findings demonstrate that the readiness of adopting SPACE influences perceived ease of use (PEU) and perceived usefulness (PU). Self-efficacy (SE) influences PEU and intention to use (ITU); PEU influences PU; PEU influences attitudes toward users (ATT); and PU influences ATT. Interestingly, PU had no impact on the ITU. The desire of TPEP students to use the SPACE-LMS is also influenced by their sense of self-efficacy. Thus, this study has both theoretical and practical implications.

## KEYWORDS

learning management system, teacher professional education program, technology acceptance model, self-efficacy, Indonesia

## 1 Introduction

The COVID-19 pandemic has made online learning a critical requirement for learning activities in many universities worldwide (Al-Ghurbani et al., 2022; Yao et al., 2022). This overcomes the limitations of in-person instruction brought forth by COVID-19 (García-Peñalvo et al., 2021). Consequently, both students and instructors need to immediately transition to online learning and teaching platforms, respectively (Bao, 2020). One of the online platforms that have received the greatest amount of use over that time period is the learning management system, also known as LMS (Aldiab et al., 2019). The learning management system (LMS), a relatively new technology extensively employed in higher education, is considered an information and communication technology tool used in the educational sector (Al-Mamary et al., 2022). Dahlstrom and Bichsel (2014) reported that 99% of universities claim to have an LMS in place, and 56% of students say that they use it for most

or even all their courses. During COVID-19, several universities took advantage of the functionality offered by the LMS to develop online teaching and learning approaches (Su and Chen, 2022).

In a similar vein, to support the implementation of the Teacher Professional Education Program (TPEP) in positions for religious subjects at madrasas and schools, the Ministry of Religious Affairs of the Republic of Indonesia has developed a one-of-a-kind learning management system (LMS) for studying religion during the pandemic. This system is called *Sistem Pembelajaran Agama Cara Elektronik* (SPACE). TPEP instructors are expected to have a strong interest in adopting SPACE-LMS, the flagship initiative of the Ministry of Religious Affairs, to enhance the learning process on a digital platform that allows for individual learning (Sumantri, 2021). This is reflected in the data provided by the ministry.

According to the Ministry of Religion in 2022, 929,501 teachers took part in the TPEP program, of which 61% were Madrasah Teachers and 39% were Islamic Religious Education teachers in schools. The TPEP committee (2022) reports that 9,826 teachers are currently participating in TPEP under the Ministry of Religion in 2022. It is interesting to note that 4,508 participants (45.87%) were older than 40. This group of educators has some characteristics, such as the age of 40, and they are known as digital immigrants and those who were born before digitalization (such as Generation X and baby boomers). Therefore, most instructors have been sluggish in adopting new technology. Consequently, technical literacy is one of the most important factors influencing LMS adoption. If this is the case, the capacity of teachers to use technology to accomplish particular aims is related to teaching skills. Consequently, it should come as no surprise that the levels of attitude, competence, and behavior surrounding the usage of technology systems will indeed vary (Su and Chen, 2022). It was discovered from the occurrences observed in the field that some TPEP participants had extensive knowledge of information systems, while others did not. The objectives can be diverse, including finding information online, learning new things, establishing connections online, completing tasks, and learning via the Internet. Thus, they must be able to master and use it to keep students motivated and attentive, as the use of SPACE-LMS in the TPEP program may make it difficult for participants to accept it (Surya Siregar et al., 2022) and eliminate the actual participants-instructors' interactions that encourage learning and knowledge retention in the classroom (Yao et al., 2022).

The teacher implementing this TPEP, of course, has a considerable influence on the scenario, depending on their degree of self-efficacy. The notion that one can act to attain a goal or that one can practice self-control is known as self-efficacy (Eraslan Yalcin and Kutlu, 2019). This is in line with Bandura (1982), who stated that people with self-efficacy are aware of their capabilities and can successfully arrange their activities. On the other hand, it is very possible that some participants in the TPEP struggle with self-control and prefer putting off their tasks in the LMS. According to Yao et al. (2022), it has been shown that online students commonly cheat on their assignments and assessments and that they have low academic performance overall. The present study also acknowledges that students are the primary object of learning and that studies of online learning must take into consideration students' levels of self-efficacy to ascertain and improve the necessary information and skills in online learning. In particular, self-efficacy has a more

substantial impact on attitudes and behaviors when students study on their own in an environment that is not under the direct supervision of an instructor. Early research on online education emphasized how students felt about studying online and how eager they were to do so (Al-Ghurbani et al., 2022; Al-Mamary et al., 2022). However, very little is known about how students perceive their own ability to study online.

The Technology Accepted Model (TAM) emerges as one of the most reliable foundational research models for studying the adoption of new technologies. TAM is frequently used in numerous studies, while others extend it to contextual factors. For example, Ariff et al. (2012) included self-efficacy with the TAM factor to study behavioral intentions toward Internet-based banking systems. Scherer et al. (2019) investigated the impact of TAM variables on teachers' adoption of digital technology in classrooms. Mohammadi (2015) evaluated the TAM and D&M integrated model to examine the effects of usability on user intention and satisfaction as well as the mediating effects of usability on e-learning use in Iran. To quantify the components that explain behavioral intentions and establish the relevance of the relationship between various variables and behavioral intentions, research is being conducted on the scope of the development and validation of the TAM (Chintalapati and Daruri, 2017). Additionally, Legris et al. (2003), Li et al. (2011), and (Sulamsi and Dalle, 2022) on the influence of a teacher's external elements on embracing technology for learning, as well as a number of other studies, have all been conducted by Davis et al. (1989), Liao et al. (2018), Park et al. (2020), and Antonietti et al. (2022).

The TAM is often applied in studies on the use of electronic services in a range of fields, ranging from economics to education. Nevertheless, even now, few studies have investigated the function of TAM in the usage of the Electronic Method of Religious Learning System (SPACE; Fitri and Budiyo, 2022). Given the research vacuum, the objectives of this study were to investigate how LMS-SPACE is utilized in the TPEP and how it interacts with the TAM and with participants' levels of self-efficacy. The TAM model's integrated self-efficacy in assessing technology adoption was the topic of the study, and it involved teachers who were currently enrolled in TPEP. The majority of the participants were over the age of 40 years or were part of a group that transitioned to using new technologies. This makes the study extremely interesting. Despite this, the LMS-SPACE variable was included in the TAM as an external variable. It is anticipated that the findings of this study will add to the existing body of knowledge regarding the implementation of innovative technologies in the field of education as well as the existing body of literature regarding the efficient utilization of LMS by respondents who are digital immigrants. According to Quansah (2021) and Al-Mamary et al. (2022), the first step in the success of an LMS in any educational institution is the adoption of technology by students. Students are motivated and encouraged to use LMS because of their widespread acceptance in the academic community. Considering this, it is important to investigate the factors that impact TPEP instructors' motivation to utilize an LMS, as this will determine the efficacy of the program and improve the long-term use of e-learning. The primary objective of this research is to evaluate the TAM and self-efficacy of students in Indonesia to determine whether these students have the desire to utilize SPACE-LMS in light of the information that has been presented.

## 2 Theoretical background and hypothesis development

### 2.1 Theoretical background

#### 2.1.1 SPACE application as part of a learning management system

The learning process has evolved in the educational sector as a direct consequence of advancements in technology, which have made the learning process both more effective and efficient. In higher education, the learning management system, often known as an LMS, is one of the most frequently used tools for bridging the learning process (Cheng et al., 2022). For some people, the word “LMS” may refer to the system itself, whereas for others, it may refer to the benefits and qualities that are made available by using this system. It has the potential to boost learning capacities, such as through the sharing of cutting-edge knowledge and online interaction between instructors and learners that takes place outside the typical classroom environment (Belovich et al., 2022; Cheng et al., 2022). In general, it is a web-based program that assists educational institutions in the development, implementation, and evaluation of learning systems (Gillett-Swan, 2017; Taft et al., 2019). It is widely used in universities and other organizations in the higher education sector to construct vast digital instructional infrastructures (Al-Mamary et al., 2022). In addition, Al-Nuaimi and Al-Emran (2021) state that a number of researchers have speculated on the possibility of enhancing educational standards through the use of technology (such as LMS).

As part of Indonesia’s Teacher Professional Education Program, the Learning Management System (LMS) is currently being implemented in classrooms (TPEP). Learners attending TPEP utilize SPACE, which is an electronic religious learning system, as a learning management system. This LMS was created by the Directorate General of Islamic Education (Sumantri, 2021). Figure 1 illustrates how this SPACE-LMS makes it accessible to users of all the educational materials utilized in madrasas and religious organizations. The TPEP participants were accountable for their independent education via the

LMS. This education should always begin with comprehension of the learning contract, modules, and exercises. Students who are enrolled in TPEP but do not utilize SPACE-LMS will struggle, and their TPEP competency will decline. As a result, TPEP’s graduation rates, which are now less than 90%, will decrease. The TPEP program requires digital capabilities to handle each task that must be accomplished in accordance with standards. If students/instructors are literate and comfortable with digital technology, they will have a significant impact on the process and their ability to graduate.

Educators and Learners now have a new perspective on education because of the LMS revolution, and how users perceive technology will impact how they interact with it (S. H. Alshammari, 2020). One of the factors that may influence this is the user’s assessment of the usefulness and ease of use of this technology as a reasoned action in the context of technology users (Cheng et al., 2022; Eraslan Yalcin and Kutlu, 2019; Hung, 2021). As a result, an individual’s actions or behaviors may be utilized as a benchmark in the adoption of a technology based on their reasons for recognizing the benefits and ease of use of the technology (S. H. Alshammari, 2020). Therefore, this study considers LMS perception as an external factor influencing the adoption of innovative technologies such as SPACE-LMS.

#### 2.1.2 Technology acceptance model as a prominent adoption technology model

In the revolution 4.0, the use of technology in education has become a significant concern. Many theories, such as the Theory of Reason Action (TRA), Theory of Planned Behavior (TPB), and the Technology Acceptance Model (TAM), are frequently employed by researchers to understand user behavior in the adoption of technology. Over the years, considerable empirical evidence has been obtained (Al-Mamary et al., 2022). Every time a theoretical model involving the adoption of a new technology is addressed, TAM is widely seen to be a very important and generally accepted model for people’s acceptance of technology (Scherer et al., 2019). Various models and ideas have been applied to research technology adoption (Chintalapati and Daruri, 2017). The TAM is unquestionably one of the most often



FIGURE 1  
SPACE main menu display. Source: <https://space.kemenag.go.id/>.

applied models in the field of technology adoption (Taherdoost, 2018). A thorough model-based TAM was utilized in a recent study by Allam et al. (2024) to analyze the acceptance of LMS in higher education institutions in Dubai, United Arab Emirates. TAM is a leading postmodern concept that helps explain how people accept and use the latest technology (Rad et al., 2022). The TAM model is adopted from the theory of reasoned action model, which is a TRA with the premise that a person's reaction and perception of something will determine that person's attitude and behavior (Davis et al., 1989; Susanto et al., 2022).

The use of information technology remains a challenge in education and training, especially in TPEP under the Ministry of Religion. Its use is in the form of LMS, which is called SPACE. Of course, in this adoption, there will be supporting and inhibiting factors, one of which is the attitude of accepting new things in terms of technology. The application in LMS-SPACE is the latest thing felt by every student studying. Given that this is closely related to the use of SPACE and new applications for teachers, it will be discussed using the TAM. The TAM aims to explain and predict user acceptance of the factors that affect user acceptance of technology.

The TAM model, which was derived from psychological theory and is based on links between user behavior (Muchran and Ahmar, 2019) and beliefs, attitudes, and intentions, explains the behavior of users of new technologies (Marangunić and Granić, 2015). This model explains the key drivers of user behavior toward technology acceptance (Xu and Lu, 2022). TAM provides a more thorough explanation of IT acceptance through the use of several characteristics that may influence IT user acceptance, or the fundamental theory underlying studies that forecast user adoption of technological innovations (Xu and Lu, 2022; Yao et al., 2022). According to Davis, five elements affect how a system is used (Chuttur, 2009). The first is *perceived usefulness* (PU), which refers to how much a person thinks utilizing the system will help him perform better at work. The second is *perceived ease of use* (PEU), which is the degree to which a user thinks that utilizing the system is not challenging. The third category is *behavioral intention* (BI): propensities to employ technology. The *actual use* (AU) comes in at number five, followed by *attitude* (ATT) toward using. TAM is utilized as a study variable to assess user acceptance of a system or an information system that is being developed or is already operational (Zhao and Tu, 2022). Finally, we used an external variable in this study, which is the perception of LMS-SPACE.

### 2.1.3 Self-efficacy

Self-efficacy is a term used to describe a person's perception of their own competence in specific challenging activities that could involve novel, challenging, and potentially stressful elements (Bandura, 1977, 1981, 1982). Self-efficacy, which relates to a person's capacity for action, is a crucial component for people (Guðmundsdóttir, 2022). Along with knowing what needs to be done, it also entails having an emotional wherewithal to carry it through. Self-efficacy is thought to have a variety of effects on a person's ability to exert control over accomplishments (Bandura, 1977; Schunk, 1984). According to Woolfolk and Shaughnessy (2004), self-efficacy is an evaluation of one's ability to perform a certain task. According to Bandura (1977), a person's confidence in their talent influences how they react to particular circumstances or settings. Thus, self-efficacy is an individual's belief in their ability to achieve anything (Simoneaux,

2022), whether it is producing something, organizing, achieving predetermined goals, or taking measures to develop specific talents. Self-efficacy is a shorthand term for confidence in one's abilities (Furstenberg and Rounds, 1995). Self-efficacy can affect decisions regarding what to do (Marquez et al., 2022). In the context of learning, students who evaluate themselves higher or have a higher desire to gain cognitive abilities should participate more and be more excited about all tasks. Students with a lower desire to acquire cognitive skills may try to avoid tasks (Bandura and Schunk, 1981; Brown and Inouye, 1978; Schunk, 1982). Self-efficacy also affects a person's level of performance skills (Schunk, 1981, 1984).

Self-efficacy has a significant impact on how one's cognition, emotions, and social environment influence behavior (Cao et al., 2022). In line with this, Bandura (1981, 1982) claimed that people learn about their self-efficacy level in a given field. For instance, in the pursuit of performance, experience, observation, social influence, and interpretation of physiological states. According to Pate et al. (2022), failure can often lower a person's self-efficacy, whereas repeated success can increase it. Students learn a lot about their own capabilities in lectures by understanding how others accomplish a task (Schunk, 1984). Others may feel more confident that they can complete a task after seeing a colleague complete it successfully. In conclusion, it has been hypothesized that educational practice has a significant contextual impact on a person's sense of self-efficacy (Schunk, 1984).

In practice, student self-efficacy is essential for the success of the TPEP program. This has to do with how much a person believes they can accomplish particular goals, and each of them will have a significant impact on that. Each member must have confidence in their skills, a solid commitment to the project, and the ability to be tough in order for the LMS Space to be used effectively. When someone has high self-efficacy, they are more likely to accept LMS-SPACE and find it simple to learn and comprehend. It will be quite challenging for them to comprehend all the many activities and bills in LMS-SPACE if their self-efficacy is weak.

## 2.2 Research framework

The results of various studies have shown that the use of a system or technology has an impact on usage intentions, including research by Jin (2014), who found that compatibility (COM) significantly influences e-book users' perceptions of usability. Usage (PEU), and user perceptions of e-book usability (PU). The study also demonstrates that perceived ease of use (PEU) has a significant positive impact on perceived usefulness (PU) of using e-books, perceived ease of use (PEU) has a significant positive impact on satisfaction (ATT) of using e-books, and perceived usefulness (PU) has a significant positive impact on satisfaction (ATT) with the use of e-books. The same findings—that PEU is significantly and favorably associated with PU, and that PEU and PU have a significant and favorable association with ATT—were also drawn from research by Hu et al. (2022). Additionally, Lin et al. (2020) demonstrates that Attitude Toward Using (ATT) in using mobile learning has a favorable impact on Behavioral Intention To Use (BI). Additionally, Lee and Wella (2018) demonstrated that behavioral intention (BI) has a favorable and significant impact on the actual usage (AU) of e-learning. This indicates that some research demonstrates a relationship between TAM and the utilization of technology (Cheng et al., 2022). The findings of various studies also

support the research hypotheses within the research framework (see Figure 2).

## 2.3 Hypothesis development

### 2.3.1 Readiness to use LMS, perceived ease of use, and perceived usefulness

Readiness for LMS adoption as an external variable and the choice of Preparedness of LMS adoption as an external variable were positioned because user readiness cannot be isolated from the success of technological adoption. Following previous studies (Alkhateeb and Abdalla, 2021; Juhary, 2014), the successful adoption of new technologies has a significant impact on readiness for LMS adoption, which leads to ease-of-use study materials and enhances users' experience. According to Maslov et al. (2021), owing to learning technologies, it is easy to prepare user materials that are fundamentally easy to use and develop conceptions regarding perceived usefulness. In this study, the more teachers, i.e., as users adopt LMS-SPACE as a new technology, the more of an impact they will have on perceived usefulness (PU) and perceived ease of use (PEU), according to studies on the TPEP program. Therefore, we speculated that.

*Hypothesis 1: Readiness to use LMS positively affects perceived ease of use.*

*Hypothesis 2: Readiness to use LMS positively affects perceived usefulness.*

### 2.3.2 Perceived ease of use and perceived of usefulness

Furthermore, the degree to which a person thinks using a given system does not involve much work is known as 'perceived ease of use' (PEU; Davis et al., 1989). This variable identifies a person's propensity to use or refrain from using an application, depending on their perception that the application will enhance their present or upcoming

activities. The different ways people perceive ease of use have an impact on how well they do at work, and if someone uses technology because they find it difficult, their performance will suffer (Davis, 1989). Another study indicated that PEU and perceived usefulness (PU) interact in TAM (Scherer et al., 2019; Baby and Kannammal, 2020). According to Davis et al. (1989), perceived usefulness (PU) refers to how much a person believes that using a specific system will benefit them. This variable exemplifies the pragmatic principle that, even if an application is thought to be useful if it is difficult to run or use, then the benefits will be offset by hard work or the effort needed to use the application so that it does not appear to provide any benefits to its users (Türker et al., 2022). According to the system adoption logic, no matter how hard a person works, a system that cannot assist a person in performing his or her job will not be accepted (Robey, 1979). Therefore, we predicted that:

*Hypothesis 3: Perceived ease of use (PEU) positively affects toward perceived of usefulness (PU).*

### 2.3.3 Perceived ease of use and attitude toward using

Based on the study by Dasgupta et al. (2002), Attitude Toward Using (ATU) is the way a person feels about using a system to carry out a present activity. It also refers to a person's propensity to respond favorably or unfavorably to ideas, objects, people, or circumstances (Fishbein and Ajzen, 1975). When someone uses technology for work, ATU is understood as their attitude toward that person's usage of the system, expressed as acceptance or rejection (Davis, 1989). According to some experts, aspects that influence individual behavior include the attitude component. Cognitive/perspective and affective and behavioral components all play a role in a person's attitude (Svenningsson et al., 2022). Moreover, Eraslan Yalcin and Kutlu (2019) demonstrated a significant relationship between perceived ease of use and intention to use that contributes to the attitude toward using something, that is, cooperative learning (Quansah, 2021). Furthermore, there is a positive relationship between perceived

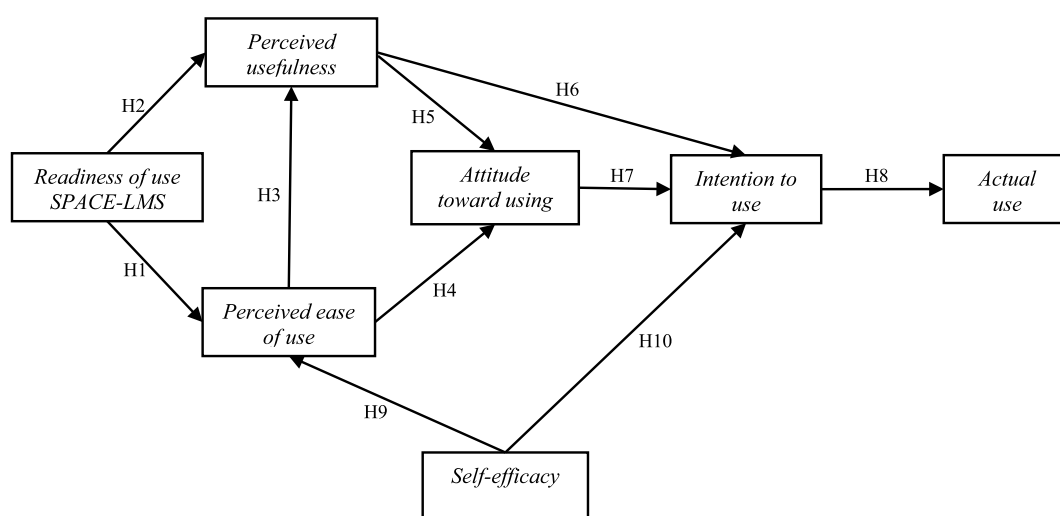


FIGURE 2 Research framework.

usefulness and attitude toward using electronic invoices (Al-Mamary et al., 2022; Setiawan and Setyawati, 2020). However, Perangin-angin et al. (2016) did not find any effect of perceived ease of use on attitude toward using an electronic invoice in the Indonesian context. Moreover, a study conducted by Renny et al. (2013) showed that perceived usefulness influences attitudes towards the usability of airline ticket reservations more strongly than perceived ease of use. Thus, there is an inconclusive argument regarding the impact of perceived ease of use and perceived usefulness on attitudes toward using. Therefore, it is necessary to examine the relationship between these variables in order to better understand and enrich the current literature. Therefore, we predicted that:

*Hypothesis 4: Perceived ease of use (PEU) positively affects on attitude toward using (ATU).*

*Hypothesis 5: Perceived usefulness (PU) positively affects attitudes toward using (ATU).*

*Hypothesis 6: Attitude toward using (ATU) positively affects on intention to use (ITU).*

### 2.3.4 Perceived usefulness and intention to use

The intention to use something or a belief that establishes a connection between trust and the conduct that results from it is known as the intention to use (Fishbein and Ajzen, 1975). Intentions impacted by attitudes toward a particular activity can be a reliable predictor of that behavior's manifestation (Naserrudin et al., 2022). A behavior's intention can serve as a powerful predictor of its actualization (Fishbein and Ajzen, 1975). A person's intention or interest in using something that, in this study, is tied to the use of information technology in the form of SPACE (Sumantri, 2021). This is further supported by Letchumanan and Muniandy (2013), who found a positive relationship between perceived usefulness and intention to use. Mensah (2020) found the relationship between the Perceived usefulness (PU) and intention to use (ITU) of the mobiles. Moreover, Letchumanan and Tarmizi (2011) confirmed a positive relationship between perceived usefulness and intention to use learning materials. LMS specifically created for TPEP students in higher education. The purpose of this study is to determine whether or if students are interested in using LMS SPACE during TPEP lectures. Therefore, we hypothesize the following:

*Hypothesis 7: Perceived usefulness (PU) positively affects toward intention to use (ITU).*

### 2.3.5 Intention to use and actual use

Actual Use (AU), often known as actual users, is the Use of technology in its actual context (Dasgupta et al., 2002). In this study, students in the Teacher Professional Education (TPEP) program were the users of the system. The actual Use of the system was envisioned in terms of calculating how frequently and for how long people utilize technology (Davis, 1989). A person will be content utilizing technology if they think it is simple to use and will boost their productivity, which is represented in actual usage circumstances (Purohit et al., 2022). The main purpose of the final model is to summarize user attitudes and expectations of actual use (Bhattarai and Maharjan, 2020). The user's attitude toward technology, as well as their

intention or interest in utilizing it, is determined by perceived usefulness and simplicity of use, which in turn affects actual use (Elkaseh et al., 2016). Tao et al. (2022) found a positive relationship between intention to use and actual use. Therefore, we propose the following hypothesis:

*Hypothesis 8: Intention to use significantly and favorably influences actual use.*

### 2.3.6 Self-efficacy and perceived ease of use

Self-efficacy (SE) affects how simple users believe a technology or system to be used. This is based on a number of earlier studies, including one by Alassafi (2022), who discovered that self-efficacy (SE) significantly and positively affects perceived ease of use (PEU). Jin (2014) reached the same conclusion, revealing that self-efficacy (SE) has a considerable impact on e-book readers' perceptions of usability (PEU). Furthermore, Wang et al. (2013) and Liu et al. (2022) reported that numerous studies supported the notion that self-efficacy favorably increases the intention to use (ITU) to embrace technology (Ariff et al., 2012). Hence, the following hypothesis was developed:

*Hypothesis 9: Self-efficacy will have a significant and positive effect on perceived ease of use.*

*Hypothesis 10: Self-efficacy has a significant and positive effect on intention to use.*

## 3 Method

### 3.1 Data collection

This study adopts a quantitative research approach using a survey questionnaire. An online survey was devised with the goal of collecting information from all educators who were taking part in the teacher professional education program (TPEP) in the province of West Sumatra-Indonesia. As this study employs the LMS-SPACE program, it is unable to obtain samples directly; therefore, online surveys are a suitable alternative. In the next step, a probability-based strategy is used in this study, considering each TPEP member in 2022. The technique of collecting data known as random sampling involves offering everyone an equal opportunity to be selected as responders. Sharma (2017) asserts that although this method requires greater effort, it is far more accurate. Henceforth, an online survey questionnaire was distributed to 418 teachers who had taken part in West Sumatra Province's 2022 teacher professional education program. Participants were requested to provide their feedback anonymously. The research was conducted with 245 individuals, representing a response rate of 58.61%. In terms of impact, the sample size was appropriate for the conditions set for the sample. The smallest sample size required for a specific effect size and power level will be found using a sample size-determination power analysis (Giner-Sorolla et al., 2024). According to Hair et al. (2014), the sample size has to be at least 5–20 observations per item to obtain a research power of 0.8 with an alpha of 0.05. The conceptual framework and hypotheses of this research were examined using the partial least squares structural equation modeling (PLS-SEM) approach. The PLS-SEM method, as outlined by Hair et al. (2019), is appropriate for evaluating this

relationship, because it examines complicated model assumptions. We assess the procedural and statistical measures taken to control method biases, in accordance with Podsakoff et al. (2012), and offer suggestions for reducing method bias in the research. In addition, to avoid any potential social desirability bias or other biases in self-reported metric. Because the issue of our study is not sensitive, there is less chance of bias. In general, respondents may choose to answer questions in a way that portrays them favorably or is positively interpreted by others rather than based on their genuine feelings for sensitive topics (Nederhof, 1985; Podsakoff et al. (2024).

## 3.2 Measurement items

The readiness of SPACE-LMS adoption measurement was adopted from M. H. Alshammari and Alshammari (2022). The TAM variable from Cheng et al. (2022) and Mohammadi (2015). Self-efficacy was adopted from Eraslan Yalcin and Kutlu (2019). This research was conducted by assigning a score that is used in quantitative research, especially when using primary data, namely the Likert scale technique. The Likert scale technique, a common tool in quantitative research, was used to assign a score to this study using primary data. The Likert scale employed in this study ranged from 1 to 5, with 1 denoting “strongly disagree” and 5 denoting “strongly agree.” This study employs empirical research methods, which are techniques that participants actually use and see in order for others to verify the techniques employed and examine the test and confirm the results.

## 4 Result and discussion

### 4.1 Result of the study

#### 4.1.1 Characteristics of the respondent

A total of 245 completed questionnaires were returned, with a response rate of 58.61 percent. Only 222 of the returned questionnaires were usable; the rest were discarded because of incomplete responses (missing values). According to the recommendations given by Hair et al. (2019), we believe that our sample size and response rate are sufficient for this study. Participants provided information on their gender, job title, age, teaching experience, and courses taught. According to the above data, among TPEP students at the Islamic University in West Sumatra, Indonesia, 60.8% were female and 39.2% were male. If the respondents' employment status was considered (33.8% public servants, 5.8% contract employees, and 56.3% honorary), 33.8% of teachers had a tenure of more than 15 years, 49.1% had a tenure of 11 to 15 years, and 17.1% had a tenure of 6 to 10 years. 4.5% were between the ages of 51 and 60, 30.6% were between the ages of 41 and 50, 62.6% were between the ages of 31 and 40, and 2.3% were between 20 and 30. According to the respondents' facts, they had greater teaching experience on average, and their average age ranged from 31 to 50 years.

#### 4.1.2 Results and empirical estimates

A partial least squares structural equation model (PLS-SEM) was employed to examine the research findings. In line with the research conducted by Hair et al. (2019), we used SEM-PLS to execute a reflective measurement model (algorithm) and a structural model

(bootstrap). The evaluation of validity and reliability is part of the measurement model used in the first phase to ensure that measurement quality standards are met. Items with a loading factor of less than 0.70 are excluded in order to generate a specific model based on measurement tests and quality criteria proposed by Hair et al. (2019). Some items with inaccurate scores were identified by algorithm estimation and were excluded from further investigation. Table 1 shows the outcomes of the measurement evaluation after eliminating all invalid items from the variables. A second data analysis was performed to guarantee the accuracy of the measurement model.

According to Hair et al. (2019), in the first stage of the measurement model, we used the PLS-SEM technique to provide internal consistency (Cronbach's alpha/CA, composite reliability/CR), convergent validity (loading factor/LE, average variance extracted/AVE), and discriminant validity (e.g., HTMT). As shown in Table 1, the measurement model successfully satisfied these requirements. Each construct's composite reliability (CR) and internal consistency (IC), as measured by Cronbach's alpha (CA), were both greater than 0.70, demonstrating consistency within the construct. The average variance extracted (AVE), which is likewise over 0.50, shows that convergent validity satisfies the required level. The square root of the AVE value, as indicated in Table 2, is greater than the construct correlation, which brings us to the conclusion that discriminant validity is valid.

The structural model was evaluated in the following phases: According to Hair et al. (2019), evaluating structural models sequentially entails evaluating collinearity, the significance of path coefficients, r-square assessment ( $R^2$ ), and predictive relevance ( $Q^2$ ). Before performing the analysis, it is crucial to check for collinearity using the variance inflation factor value (VIF). There is no collinearity issue according to the inner VIF value results, which reveal that each construct has a value of less than three (Hair et al., 2019). In this study, we selected a 5% significance threshold with a  $p$ -value  $\leq 0.05$ . The path coefficients are presented in Table 3.

Based on these findings, readiness to adopt the learning management system (LMS), namely the electronic way of the religious learning system (SPACE), has a significant effect on perceived ease of use (PEU;  $\beta=0.495$ ,  $\alpha=0.000$ ). This indicates that Hypothesis 1 is supported. Then, there is a significant influence between SPACE on perceived usefulness (PU;  $\beta=0.335$ ,  $\alpha=0.000$ ), demonstrating that Hypothesis 2 is also accepted. Hypothesis 3: There is a significant relationship between PEU and PU ( $\beta=0.494$ ,  $\alpha=0.000$ ). Thus, Hypothesis 3 was supported. Furthermore, PEU has a significant effect on attitude (ATT;  $\beta=0.447$ ,  $\alpha=0.000$ ). Thus, Hypothesis 4 is accepted. In addition, the relationship between PU and ATT was significant ( $\beta=0.456$ ,  $\alpha=0.000$ ); thus, Hypothesis 5 was accepted. There was an influence between ATT and intention to use (ITU;  $\beta=0.574$ ,  $\alpha=0.000$ ). This result indicates that Hypothesis 6 is accepted. Interestingly, there was no influence of PU on ITU ( $\beta=0.094$ ,  $\alpha=0.160$ ). This result indicates that Hypothesis 7 is rejected. Furthermore, there was an influence between ITU and actual use (AU;  $\beta=0.680$ ,  $\alpha=0.000$ ). The findings support Hypothesis 8. There is a significant effect between self-efficacy (SE) on PEU ( $\beta=0.303$ ,  $\alpha=0.000$ ), as evidenced by a beta coefficient and a statistical significance, the Hypothesis 9 is supported. Finally, SE had a significant influence on ITU ( $\beta=0.197$ ,  $\alpha=0.001$ ). Thus, Hypothesis 10 was accepted. For summarizing all findings can be seen in Figure 3.

TABLE 1 Summary of measurement model analysis.

Construct/Items	LF	CA	$\rho_A$	CR	AVE
Readiness to Use SPACE-LMS (Alshammari and Alshammari, 2022)		0.890	0.891	0.916	0.646
LMS-01 I look forward to participate in SPACE-LMS.	0.786				
LMS-02 I can commit the time needed to complete the task in SPACE-LMS.	0.820				
LMS-03 I would take up a course using SPACE-LMS if it is equivalent to a conventional course.	0.809				
LMS-04 I am ready to join in course in SPACE-LMS.	0.805				
LMS-05 I like to learn more about SPACE-LMS.	0.824				
LMS-06 I am open for online assessments by SPACE-LMS.	0.779				
Self-Efficacy (Eraslan Yalcin and Kutlu, 2019)		0.904	0.905	0.929	0.723
SE-01 I can access the contents of the SPACE-LMS.	0.847				
SE-02 I can freely navigate the contents of the SPACE-LMS.	0.837				
SE-03 I can use the SPACE-LMS without needing to be told how it functions.	0.869				
SE-04 I can solve problems that arise on the SPACE-LMS.	0.861				
SE-05 I can use the SPACE-LMS if there are user manuals available.	0.837				
Perceived Ease of Use (Cheng et al., 2022)		0.885	0.886	0.929	0.814
PEOU-01 I find SPACE-LMS easy to use.	0.903				
PEOU-02 Learning to operate SPACE-LMS is easy for me.	0.924				
PEOU-03 It is easy for me to become skilful in using SPACE-LMS	0.879				
Perceived Usefulness (Cheng et al., 2022)		0.862	0.871	0.915	0.783
PU-01 Using SPACE-LMS improves my academic performance	0.852				
PU-02 Using SPACE-LMS enhances my effectiveness on study	0.920				
PU-03 Using SPACE-LMS enables me to accomplish tasks more quickly	0.881				
Attitude to Using (Cheng et al., 2022)		0.874	0.877	0.923	0.799
ATU-01 I have fun using SPACE-LMS	0.868				
ATU-02 I enjoy using SPACE-LMS	0.900				
ATU-03 Using SPACE-LMS provides me with a lot of enjoyment	0.913				
Intention to Use (Mohammadi, 2015)		0.825	0.834	0.895	0.740
ITU-01 I tend to use SPACE-LMS	0.879				
ITU-02 I believe that use of SPACE-LMS is available	0.873				
ITU-03 I am likely to use SPACE-LMS in the near future	0.827				
Actual Use (Mohammadi, 2015)	1.000	1.000	1.000	1.000	1.000

LF, Loading factor; CA, Cronbach's alpha;  $\rho_A$ , rho\_A; CR, composite reliability; AVE, average variance extracted.

## 4.2 Empirical discussion

Most of the hypotheses were accepted based on the findings outlined in the previous section. First, the study shows that electronic learning systems (SPACE) influence perceived ease of use (PEU). Readiness for LMS-SPACE adoption also influences the perceived usefulness (PU). Furthermore, it is also observed that self-efficacy (SE) has an effect on PEU, PEU also has an influence on PU. Apart from that, SE also influences intention to use (ITU), and PEU also influences attitudes towards users (ATT). Moreover, PU also affects the ATT. Interestingly, PU does not affect ITU, whereas ATT affects ITU, and ITU also influences actual use (AU).

In contrast to the earlier study conducted by Surya Siregar et al. (2022), which examined the impact of utilizing LMS SPACE on PEU, PU, BI, and AU, this study examines the effects of using LMS SPACE on all four of these variables. Because it transpires that the use of LMS

SPACE has an impact on PU and PEU, and that these two variables revealed that self-efficacy (SE) also plays a role that is nearly the same as SPACE, namely impacting PEU and ITU, while ITU also influences AU.

The findings of this study corroborate the arguments of previous scholars, such as Bandura and Schunk (1981), Brown and Inouye (1978), and Schunk (1982), that self-efficacy affects a person's choice in determining an activity. Self-efficacy makes a person confident in believing in their own ability to overcome obstacles that hinder the achievement of goals. He or she believes that he or she can achieve his or her desires, dreams and goals in an effective way (Narayanan and Ordynans, 2022).

Bandura (1977) views self-efficacy as a type of self-evaluation, particularly regarding how well a person can perform in various situations. In this study, we found that self-efficacy influenced PPG students' perceptions of the ease of use of the Learning Management



TABLE 2 Summary of discriminant validity result.

	SPACE	SE	PEU	PU	ATT	ITU	AU
Panel A: Fornell-Lacker criterion							
Readiness of use SPACE-LMS	0.804						
Self-efficacy (SE)	0.454	0.850					
Perceived ease of use (PEU)	0.631	0.528	0.902				
Perceived usefulness (PU)	0.644	0.463	0.705	0.885			
Attitude toward using (ATT)	0.665	0.540	0.770	0.772	0.894		
Intention to use (ITU)	0.575	0.550	0.708	0.705	0.755	0.860	
Actual use (AU)	0.411	0.409	0.542	0.462	0.502	0.681	1.000
Panel B: Heterotrait-Monotrait ratio (HTMT)							
Readiness of use SPACE-LMS	1.000						
Self-efficacy (SE)	0.506	1.000					
Perceived ease of use (PEU)	0.711	0.589	1.000				
Perceived usefulness (PU)	0.733	0.521	0.804	1.000			
Attitude toward using (ATU)	0.750	0.604	0.875	0.883	1.000		
Intention to use (ITU)	0.663	0.629	0.734	0.734	0.878	1.000	
Actual use (AU)	0.435	0.431	0.494	0.494	0.533	0.749	1.000

The square roots of the AVE values (bold) are higher than the latent construct correlations.

TABLE 3 Summary of structural model analysis.

Relationships	B	STDEV	T statistics	p values	95% BCa Confidence Interval		Decision
					2.50%	97.50%	
H1 Readiness of use SPACE-LMS → Perceived ease of use	0.495	0.064	7.673	0.000	0.358	0.612	Accepted
H2 Readiness of use SPACE-LMS → Perceived usefulness	0.335	0.073	4.513	0.000	0.187	0.473	Accepted
H3 Perceived ease of use → Perceived usefulness	0.494	0.072	6.877	0.000	0.355	0.634	Accepted
H4 Perceived ease of use → Attitude toward using	0.447	0.060	7.426	0.000	0.333	0.571	Accepted
H5 Perceived usefulness → Attitude toward using	0.456	0.064	7.116	0.000	0.320	0.573	Accepted
H6 Perceived usefulness → Intention to use	0.094	0.068	1.406	0.160	-0.036	0.227	Rejected
H7 Attitude toward using → Intention to use	0.574	0.075	7.665	0.000	0.422	0.717	Accepted
H8 Intention to use → Actual use	0.680	0.051	13.245	0.000	0.568	0.769	Accepted
H9 Self-efficacy → Perceived ease of use	0.303	0.068	4.446	0.000	0.173	0.444	Accepted
H10 Self-efficacy → Intention to use	0.197	0.060	3.238	0.001	0.082	0.317	Accepted

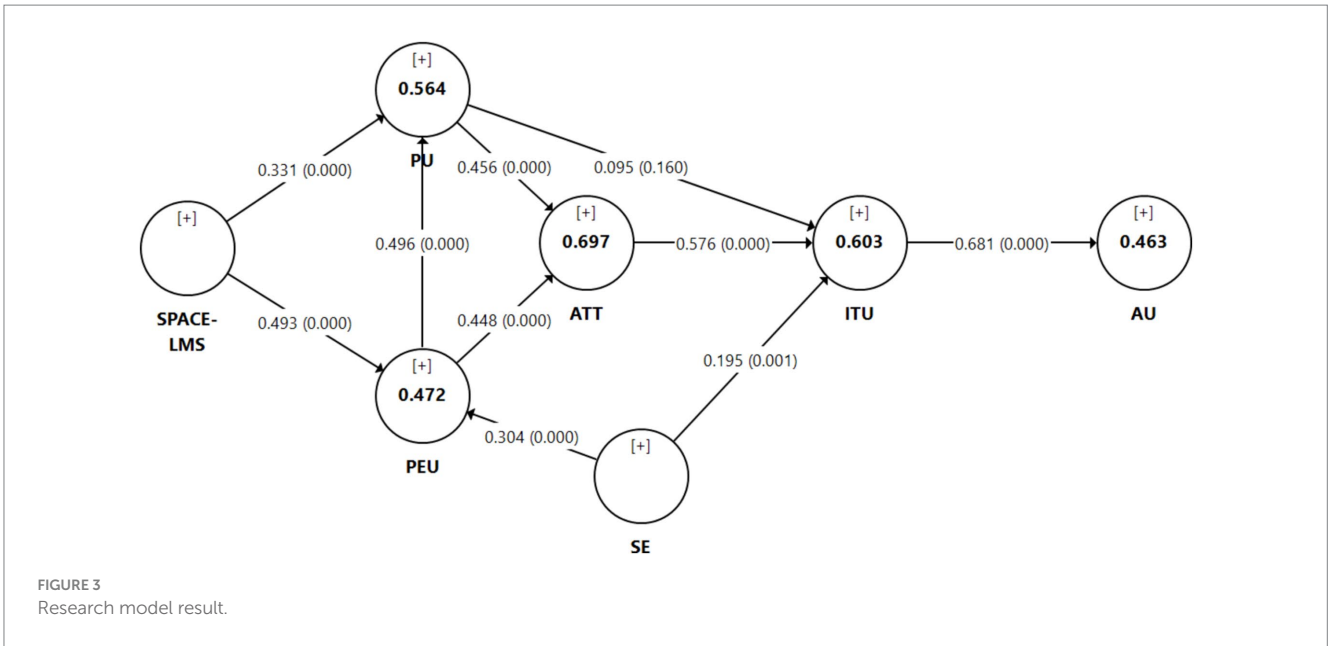
Significant at the level of 0.05.

System, namely the Electronic Way of Religion Learning System (SPACE). In addition, this research also shows that self-efficacy influences the interest of TPEP students in using the Management System Service (LMS) SPACE. These results were in line with research on online learning adaptation models in Korea (Baber, 2021).

If the prior study—specifically, the study by Primayuda and Utama (2020)—found that SE had an impact on PEU and PU. These conditions can be seen in the conceptual framework of the research. Unlike the research conducted by Suryawirawan (2020), in this study, the results or research findings showed that PEU was also influenced by the use of technology, namely, LMS SPACE, meaning that the results of this study showed the effect of self-efficacy and SPACE on PEU. In addition, research shows that self-efficacy does not affect PU

at all, but SE in this study affects ITU more. This means that in this study, the ability of Teacher Professional Education (PPG) students to use technology during lectures greatly influenced their ITU towards the use of this technology. Other research has also answered matters related to e-learning analysis using the TAM approach, which has also obtained significant results (Natasia et al., 2021).

Interestingly, this study found no significant effect between PU and ITU. Perceived usefulness is defined as the extent to which a person believes that the use of certain information systems improves performance. Behavioral interest in using technology refers to a person's desire to perform a certain behavior. It can be concluded that, in this study, there was no significant effect between perceived benefits and one's intention to do something. This proves that the perception



of the use of LMS Space has nothing to do with TPEP students' interest in LMS SPACE. This conclusion supports the findings of Ramayah and Ignatius (2005), who found that PU did not significantly influence the intention. This investigation thinks that other variables, such as the age of LMS users, may influence this unexpected outcome.

PU remains a vital component of technology adoption model; however, its influence can be lessened by various factors and external conditions. In certain instances, PU may not exert a significant direct effect on users' intentions, emphasizing the necessity of considering broader contexts and user expectations. In competitive markets, where technologies or services are well-established and highly functional, users may come to regard usefulness as a given, causing other factors to assume a more prominent role than PU. For example, a study on mobile food delivery apps by An et al. (2023) found that trust and perceived ease of use (PEOU) influenced user intention more than perceived usefulness (PU). This suggests users prioritize ease and reliability over usefulness. Familiarity with technology can also lessen the importance of PU. When users see technology as low-risk, PU may matter even less. Research on digital payment systems by Bhatia et al. (2023) showed that trust and compatibility are often more important than PU. Different cultures and behaviors can lead users to value other aspects of technology more. A study of Chinese consumers by Ashfaq et al. (2019) found that perceived enjoyment and social influence might be more influential than PU in adopting certain services. In other words, PU is not only insignificant in LMS adoption but also in other contexts, depending on specific circumstances and external conditions at the time.

In addition, this study also shows that the use of the Learning Management System, namely SPACE, in Teacher Professional Education (TPEP) lectures has implications for students' ability to use Learning Management System services during the lecture process. The use of SPACE during TPEP lectures affects perceptions of the ease and utilization of these services. This situation shows that even though TPEP students consist of people of all ages, ranging from young to very senior, these students are literate about technological

advances. The research focused on the use of e-learning by integrating the TAM model (Mohammadi, 2015). This is a positive aspect because not only young people but also senior teachers are currently able to operate technology for educational purposes, especially in terms of learning. In addition, the findings from this study show an increase in student interest in using the SPACE Management System Service during TPEP lectures. This means that the presence of the Learning Management System, which was deliberately designed by the Directorate General of Education, greatly facilitated teachers in TPEP lectures. With the increasing interest of students in using and utilizing LMS, SPACE in learning indirectly also increases their self-efficacy.

## 5 Implication, limitation, and future research

### 5.1 Implications

This study offers significant implications for the current literature, theory, and industry stakeholders. First, it is observed that all relationships in the TAM model are significantly linked, with the exception of the relationship between PU and ITU. In other words, PEU and PU in the TPEP program will be influenced by the readiness for SPACE-LMS adoption as an external variable in TAM. This strengthens the application of the TAM model in the case of using LMS during the COVID-19 pandemic and beyond. Thus, it can be argued that the use of LMS would enhance the self-efficacy of the teachers, that is, users, while the experience of the learners will also be positive, since they will understand better. Moreover, this study affirms the arguments that self-efficacy can affect PEU and ITU's use of SPACE-LMS during the Teacher Professional Education (TPEP) lecture process.

Using LMS-SPACE to increase self-efficacy and accept technology in the form of TAM allows participants in the TPEP to gain knowledge

and understanding. It is said that using the SPACE-LMS has made it simple for TPEP lecturers and students to learn all courses. However, using LMS-SPACE is complicated by a number of factors, including participants' IT and digital mastery (who typically attended technology-savvy), online time management, Internet outages, and internal student limitations, such as their capacity to adopt technology and their individual levels of self-efficacy. 87.37 percent of the participant who took TPEP with these restrictions, and 12.63% need to be strengthened and enriched once more because they were still unsuccessful.

The findings of the study would also be effective for various stakeholders such as learners, practitioners, and policymakers. Learners, teachers, and even other associated stakeholders would be aware of the electronic method of religious learning, perceived ease of use (PEU), perceived usefulness (PU), self-efficacy (SE), intention to use (ITU), and attitude (ATT). In this regard, the main stakeholder, that is, students, would be immensely benefited from this study. Furthermore, the study is also a significant platform for key decision makers in educational institutions where adopting technologies is not easy because of many resistance factors, such as the reluctance of many lecturers and admin officers. Moreover, the outcome of this study can also be effective for the decision makers of educational ministries in Indonesia and other similar countries with the same religion and economic contexts.

Moreover, the results of this study would have major implications for managers, that is, practitioners in the education industry in Indonesia and other countries, especially in developing countries. This is because the study shows how they could use electronic methods to enhance the intention to use and develop the attitude of both lecturers, that is, teachers and students. The success of the education, especially using the technologies, depends on both teachers and students; therefore, the results of this study would enhance the current understanding of practitioners on how to harness the use of learning management systems for better teacher and learner understanding.

Furthermore, unexpected lockdowns or any other viral disasters can occur in the future when the stakeholders of the educational institutions are urged to stay home and continue their activities, that is, teaching for teachers and studying for students. In this regard, the results of this study could be effective because they highlight key aspects of online or technology-oriented mechanisms for teaching and learning in an efficient and effective way. This study confirms that by using SPACE-LMS, practitioners in any situation can develop the self-efficacy of teachers or trainers and motivate them to accept technology in the form of TAM. In this regard, it is also assured that participants, that is, learners in the TPEP, can gain knowledge and clear understanding.

## 5.2 Limitation

It was vital to provide students with more assurance that they could use the SPACE learning-management system. This is due to the fact that the more assured the students are, the more they are confident in the ease and advantages that SPACE-LMS offers during the lecture process. This conviction positively influences students' attitudes and motivates them to use current technological advancements in education, particularly during TPEP lectures or other learning processes.

The use of SPACE-LMS by TPEP students under the Ministry of Religion of the Republic of Indonesia is the focus of this study, which examines a number of factors. First, the Ministry of Religion's TPEP students were religious teachers, with an average age between 35 and 55 years. Adjusting to IT improvements during these two eras can be challenging. Meanwhile, the SPACE-LMS system compels them to benefit from this technology. Therefore, the findings of this study show that contrary to the various assumptions and hypotheses advanced, there is a strong relationship between the use of SPACE-LMS, TAM, and student self-efficacy.

## 5.3 Future research

This study, which uses only two external variables in the TAM model, has limitations in addition to the conclusions that have been stated. Therefore, additional research should be conducted to fill the gaps left by this study. To determine which factors other than the two that have been studied can improve a person's perspective and interest in using computer technology for learning, further external variables can be included in future research. For the research's findings to be more focused and accurate in their representation of the many extant disciplines, further study may look at a larger sample and select fields other than education, such as economics and agriculture.

The shortcomings of this study's attempt to build a reliable research system, research methodology, and data collection could be addressed in future studies. First, there could be bias in the data-gathering process, which would reduce the external validity of the study's findings. When gathering data through online questionnaires. The use of self-reported data, which can cause biases in quantitative analysis; so, in order to confirm qualitative findings with qualitative data, future research should take a mix-method approach. Second, this study was largely cross-sectional in nature. Therefore, the results of the investigation can only describe a person's current predisposition to using TPEP learning with SPACE-LMS. The ensuing influence, however, cannot be noticed directly because it necessitates long-term observation and comparison, as different types of respondents in SPACE-LMS learning have distinct functional features and match persons in unique ways. It is necessary to more accurately assess its relationship with efficacy when comparing various platforms. In the future, a longitudinal strategy should be taken into account to lessen the study's limitations.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

ZS: Writing – original draft, Writing – review & editing. MH: Writing – original draft, Writing – review & editing. PS: Writing – original draft, Writing – review & editing. MI: Writing – original draft, Writing – review & editing. HH: Writing – original draft, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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