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# Understanding Antecedents of Learning Management System Usage among University Lecturers Using an Integrated TAM-TOE Model

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**Abstract:** Even after the COVID-19 pandemic, the use of the learning management system (LMS) is still low among university lecturers in the Kurdistan Region of Iraq. The objective of the current study is to understand the factors influencing LMS usage in universities using indicators from Technology Acceptance Model (TAM) and Technology–Organisation–Environment (TOE) framework. This study examined system quality, service quality, information quality, technical support, and government policies as essential variables for affecting LMS usage using perceived ease of use (PEOU) and perceived usefulness (PU) as mediating variables. To reach the aim of this study, the conceptual model was proposed based on TAM integrated with external factors adapted from TOE framework. Quantitative research using a questionnaire was conducted on a sample of 393 lecturers. The study used a structural equation modelling technique, and the results were analysed by SmartPLS 4.0 software. The findings show that information quality significantly correlates with PU and PEOU. Service quality, system quality, and government policy show a significant relationship with either PU or PEOU. However, technical support shows an insignificant relationship with PU and PEOU. Inside the TAM itself, PU and PEOU significantly correlate with LMS usage. Finally, the current study demonstrated the role of PU and POEU as mediators between external factors and LMS usage. These study findings have implications for research and practice to guide university leaders and policymakers in understanding the factors that must be addressed.

**Keywords:** learning management system; usage; TAM; TOE; Iraq; Kurdistan Region



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## 1. Introduction

Although LMS platforms have been widely used in universities worldwide, the use of LMSs is low in developing countries. Even after the COVID-19 pandemic, the challenge faced by universities in the Kurdistan Region is its lecturers' minimal use of LMS technology. The government of the Iraqi Kurdistan Region has invested a large amount of money in providing universities with ICT tools, but the usage rate is still low among academicians [1].

It has been emphasised by many studies that ICT tools in general and LMSs in particular have significant impacts on modifying teaching methods [2]. A study by Abdulrahman [3] was conducted to investigate the lack of LMS usage in universities in the Iraqi Kurdistan Region. Most of the previous studies in Arab countries examine factors that influence the decision to use LMSs in teaching and learning from the individual perspective, while a few of them implement the organisational perspective.

From the organisational perspective, internal and external factors within universities are remarkably impacting LMS adoption and usage among academicians [4]. This study indicates technological, organisational and environmental factors that may influence the LMS usage among university academicians in the Kurdistan Region as follows.

System quality, service quality and information quality are the most critical technology factors directly affecting LMS usage [5]. Despite the importance of quality factors such as system quality, service quality and information quality, none of the research conducted in Iraq has tested these three technological factors [6], and research on this issue is limited among Arab countries [7].

Technical support, a critical organisational factor examined by many studies [8], covers providing service to academicians, which has a significant position in LMS usage [9]. When academicians receive no assistance from the IT unit while facing a technical problem, they feel that working with an LMS is a waste of time. Consequently, they quit working with it.

Government policy, as one of the critical environmental factors, is essential in Iraqi universities as the government wants to raise the international ranking of their universities by boosting learner-centred education and fulfilling the demands of students to access educational technologies [1].

This study contributes to the literature, especially TAM literature. The TAM model is well known in the literature across a wide range of technology adoption studies for successfully predicting and explaining the actual usage of technology [10]. Thus, the basic model to be utilised in this research study is going to be TAM, and some of the constructs of TOE framework are also being added to make the proposed theoretical framework more relevant in the case of LMS usage. This study suggests that the degree of PEOU and PU of LMS adoption is affected by factors related to technology, organisation, and environment. These three groups are part of the TOE framework; the TAM model's primary constructs are the PEOU and the PU. Usefulness is an important indicator, because only when lecturers believe that using LMS can improve their teaching efficiency, performance, and productivity are they willing to use it regularly. Furthermore, ease of use of LMS is an effective motivator in using LMS because lecturers can use most of the tools without studying it in detail or having deep knowledge to operate them [11]. This justifies the integration of TOE and TAM to study LMS usage.

The purpose of this study is to investigate the critical factors that influence the academicians' usage of LMS technology from organisational perspective using TAM-TOE model. In addition, this study aims to test the indirect relationship of those factors through the mediation effect of perceived usefulness and perceived ease of use. The outcome of this research is expected to benefit researchers, university leaders, policy makers, and LMS designers who are interested in factors that influence the LMS usage in the higher educational context in developing countries.

In this study, we utilize the same dataset previously employed in our earlier research [12]. This dataset, collected as part of a broader doctoral research project, allows for an in-depth analysis of various factors influencing LMS usage among academicians in the Kurdistan Region of Iraq. While our earlier study focused on pedagogical beliefs, this article examines the impact of system, service and information quality, among other variables.

## 2. Literature Review and Hypotheses Development

### *2.1. Technology Acceptance Model*

Davis [13] proposed a theory, conceptualised based on the Theory of Reasoned Action (TRA), which has been described as a credible model for assisting the evaluation of different kinds of technology information systems. It has been considered the critical model for determining the predictors of human behaviour towards technology adoption [14]. In technology adoption literature, TAM is the optimum standard ground theory [15]. The study of Mokhtar, Katan [16] recommended extra research need on adding external variables affecting perceived usefulness and perceived ease of use.

Scherer, Siddiq [17] argued that TAM alone cannot explain all relationships between technology systems and adoption behaviours. In contrast, TAM only consists of explanatory factors of perceived usefulness and perceived ease of use [14]. Nevertheless, the two primary variables of TAM do not fully reflect factors that can encourage the adoption of a technology system by individuals. The empirical testing of TAM has also stimulated

scholars to extend the model using various external variables [18]. It has been observed that TAM had become one of the most practical theoretical models in the field of using information systems for organisational development [19]. Therefore, many researchers have combined TAM with TOE framework to develop a conceptual framework model. Considering TAM's capability to predict the actual usage to a specific technology, this study assumed this model as underpinning theory to include other influencing factors adopted from TOE framework to understand the actual use of LMS.

#### 2.1.1. LMS Usage

Technology usage is defined by Davis [20] as an "individual's actual direct usage of a given system in the context of his or her job" [20]. The LMS usage refers to the lecturers' actual use of LMS as the lecturers' consistency in using LMS tools, such as content development, course delivery, and assessment features [21].

#### 2.1.2. Perceived Usefulness

Perceived usefulness (PU) is "defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organisational context" [22]. In this study, PU refers to the degree to which academicians believe that using LMS helps them in their academic jobs. According to TAM, perceived ease of use has a significant effect on perceived usefulness [23]. In addition, the result of the original TAM showed that perceived ease of use had a direct effect on perceived usefulness [13]. Many studies on the utilisation of LMS determined that PU is one of the significant drivers of actual usage among faculty members [24–26]. For instance, Fathema, Shannon [18] extended TAM in the LMS context among academicians and validated a significant influence of both PEOU and PU on the LMS's actual use. Thus, the following hypothesis is considered:

**H1.** *Perceived usefulness has a significant effect on LMS usage among university lecturers.*

#### 2.1.3. Perceived Ease of Use

Based on TAM, perceived ease of use "refers to the degree to which the prospective user expects the target system to be free of effort" [22]. In this study, PEOU refers to the degree to which faculty members believe that using an LMS will be free of effort. If an LMS is easy to use, offers benefits, and provides academic tools for the lecturers, the LMS will be more appropriate and utilised by lecturers like any other information system [27]. Many studies reveal that PEOU has a significant direct influence on LMS usage. Ngai, Poon [28] proved the significance of the linked path from PEOU to LMS utilisation. It has been exposed that PEOU had a significant influence on LMS usage. To emphasise, the findings of the previous studies on the LMS context also confirmed that PEOU had a significant influence on PU [19,24,28,29]. Many studies provided valid evidence that perceived ease of use and perceived usefulness directly influence actual use [30–32]. Based on the results of Davis [13], perceived ease of use is predicted to affect perceived usefulness, and both of them could be a determinant of actual use. It has been stated that the TAM demonstrates only around 40% of the variance in user intention, which is deemed low [33]. This problem is attributed to the two constructs of TAM, which are perceived ease of use and perceived usefulness. These concepts alone are not sufficient to justify the actual use of technology [34]. Therefore, scholars emphasise the significance of using the TAM with additional factors to improve its clarifying power [35]. In addition, the results of TAM2 and TAM3 tests have shown that PEOU and PU mediate external factors' influence on a system's actual usage [36]. Based on the above argument, the following statement is being hypothesised:

**H2a.** *Perceived ease of using LMS has a significant effect on the perceived usefulness of LMS usage.*

**H2b.** *Perceived ease of use has a significant effect on LMS usage among university lecturers.*

Rather than developing a model based on TOE and TAM to examine the critical factors influencing LMS usage in universities, the main objective of this study is to test the indirect relationship of those factors through the mediation effect of perceived usefulness and perceived ease of use. By using the serial mediation model, this study can bridge the several factors covering technological, organisational, and environmental aspects with the LMS usage. Many studies investigate indirect effect of serval factors on the eLearning acceptance through PEOU and PU as mediators because they didn't find any significant direct effect [18,21,28].Venkatesh and Davis [33] concluded that PEOU and PU are critical predictors, and that user behaviour can be predicted based on the number of benefits they gain from using a technology system. If the technology system is useful for the user's performance, then it will eventually lead to its use. Therefore, the researchers hypothesised that the identified factors of TOE may indirectly influence the LMS usage of academic staff in Iraqi universities via PEOU and PU.

### *2.2. Technology–Organisation–Environment (TOE) Framework*

The TOE framework, which was developed by Tornatzky and Fleischer [37], comprises three significant contexts: technology, organisation, and environment. It is widely utilised in quantifying technology adoption. The context of the TOE framework provides reliable empirical support for understanding users' attitudes towards technology usage [38]. These factors influence the adoption of technology and improve the performance of the organisation [39]. The model uses organisational dimensions such as technology, organisation, and environment, each of which has a specific effect on the organisational capacity to adopt new technology [40]. The dimensions used in this framework provide valuable insights into LMS adoption within the university context. Technology factors are considered as essential factors that will affect technology users, such as system quality, service quality, and information quality [41].

Moreover, the organisation context could refer to the available resources inside an organisation that facilitate the process of technology adoption [42]. In the TOE framework, the organisation context addresses the organisational characteristics that significantly impact the adoption and use of technology within the organisation. Despite all those factors that predicted in the previous studies [43–45], this study proposes technical support as one of the most significant factors that affect LMS adoption and use. Environmental context refers to any factors that affect the organisation that are outside the control of organisation. Moreover, Namisiko, Munialo [40] stated that one of the critical factors in the environmental context is government policy, which had to be considered when integrating the TOE model into the current study.

#### 2.2.1. System Quality

System quality is defined as the functionality of the information system [41]. The best system quality can lead to convenient usage of the technology system [46]. Ultimately, individuals can classify an information system's practical functions more accurately if the system's quality is high enough [47]. As a result, system quality was determined to positively impact the overall adoption and acceptability of LMSs [24,48]. A study by Fathema, Shannon [18] mentioned that system quality had positive effects of PU and PEOU on LMS usage among academicians in the universities.

Furthermore, Weaver, Spratt [49] measured LMS usage among instructors and students, determining that system quality is significant to both lecturers and students. Their research revealed that students value an LMS's resourcefulness, design, and interactivity. On the other hand, lecturers are primarily concerned with LMS technical and administrative elements. Hence, this study hypothesised the following:

**H3a.** *System quality has a significant effect on the perceived usefulness of LMS usage among university lecturers.*

**H3b.** *System quality has a significant effect on the perceived ease of use of LMS usage among university lecturers.*

**H3c.** *System quality has a significant indirect effect on LMS usage through perceived usefulness.*

**H3d.** *System quality has a significant indirect effect on LMS usage through perceived ease of use.*

#### 2.2.2. Service quality

Service quality is defined as the existence of channels that help lecturers in solving LMS problems [50]. Many studies have begun to show that service quality provided by IT staff is crucial to the acceptability of a learning management system [28,48,51]. Abdallah, Ahlan [52] examined service quality using variables such as compassion, reliability, and responsiveness. According to the findings of the study, the concept of service quality may be regarded as a critical component in mapping lecturers' behavioural attitudes towards LMS usage [52]. Empirical research has determined that technical staff inside the department is important to the adoption of technology systems [28,48,51]. The studies of Motaghian, Hassanzadeh [26] concluded that service quality has a direct influence on PU, PEOU, and the actual use of an LMS. Moreover, many studies confirmed the indirect relationship between service quality and technology usage through PEOU and PU [5,24,26] and emphasised that service quality is a useful predictor of PEOU and PU in information system usage. Kurdi, Alshurideh [53] showed that service quality had a significantly positive impact on PU of e-learning systems. Wang and Wang [24] detected a significant indirect relationship between service quality and web-based systems through PEOU and PU. So, the study hypothesised the following:

**H4a.** *Service quality has a significant effect on the perceived usefulness of LMS usage among university lecturers.*

**H4b.** *Service quality has a significant effect on the perceived ease of use of LMS usage among university lecturers.*

**H4c.** *Service quality has a significant indirect effect on LMS usage through perceived usefulness.*

**H4d.** *Service quality has a significant indirect effect on LMS usage through perceived ease of use.*

#### 2.2.3. Information Quality

Information quality refers to the desirable characteristics of a system's outputs, such as relevance, accuracy, understanding timeliness, completeness, usability, and accessibility [41]. Many scholars have declared that information quality is regarded as one of the significant determinants of the perceived ease of use and usefulness of information used [50,54]. Previous empirical research has shown that information quality has a positive relationship with perceived usefulness and ease of use [5,24,46,55]. Previous empirical research has shown that information quality has a positive relationship with PU and PEOU [5,24,46,55]. Many scholars have declared that information quality is regarded as one of the major determinants of PU and PEOU [50,54]. Abdallah, Ahlan [52] observed that information quality indirectly influences LMS intention to use LMS via PU and PEOU. Sharma, Gaur [55] confirmed the direct effect of information quality on the LMS adoption, as well as detected PEOU and PU mediating between information quality and LMS acceptance. Therefore, the study hypothesised the following:

**H5a.** *Information quality has a significant effect on the perceived usefulness of LMS usage among university lecturers.*

**H5b.** *Information quality has a significant effect on the perceived ease of use of LMS usage among university lecturers.*

**H5c.** *Information quality has a significant indirect effect on LMS usage through perceived usefulness.*

**H5d.** *Information quality has a significant indirect effect on LMS usage through perceived ease of use.*

#### 2.2.4. Technical Support

Technical support is one of the significant organisational factors that may impact LMS usage among academicians. Technical support consists of assistance from IT staff provided to the technology users to solve software and hardware problems and IT staff providing technical services to the academicians to facilitate LMS utilisation. Therefore, technical support within an organisation plays a vital role in technology acceptance [56].

Technical support is considered an essential factor that may influence LMS usage, as indicated by the many empirical studies that have examined its influence on LMS usage [57]. Research on technical support is essential for the context of Iraq since there are no existing studies that have investigated the impact of technician support on LMS usage there [58].

Ngai, Poon [28] extended TAM with technical support for studying the factors that influence eLearning usage in Hong Kong universities. The findings revealed that technical support is a critical direct factor that influences the perception of a system being easy to use and practical. In the technology adoption context, several studies indicated that technical support has a significant influence on LMS usage. In the other empirical research study conducted in Singapore, Teo [32] investigated technology acceptance among 475 teachers and determined that technical support significantly influenced LMS usage. Moreover, Sánchez and Hueros [29] extended TAM by their study, indicating that technical support had a significant influence on LMS usage. Alshammari [8] determined that PEOU and PU influenced the students' use of LMS through technical support. The perception of using LMS may improve with the help of technical support through imagining the ease of use of the system [59]. According to Zheng, Wang [9] and Baleghi-Zadeh, Ayub [60], technical support has a direct influence on technology acceptance as well as an indirect influence mediated by PEOU and PU. Accordingly, this study hypothesised the following:

**H6a.** *Technical support has a significant effect on the perceived usefulness of LMS usage among university lecturers.*

**H6b.** *Technical support has a significant effect on the perceived ease of use of LMS usage among university lecturers.*

**H6c.** *Technical support has a significant indirect effect on LMS usage through perceived usefulness.*

**H6d.** *Technical support has a significant indirect effect on LMS usage through perceived ease of use.*

#### 2.2.5. Government Policy

Government policy in this research refers to the degree to which lecturers believe that the policy of technology practice adopted by the government is useful. Gurbaxani, Kraemer [61] determined that coordinating roles and regulations regarding technology acceptance drove organisations in Singapore to adopt new technology. Government policy is considered in the current study in relation to the degree to which lecturers believe that the policy of technology practice adopted by the government is useful [62]. Some studies have examined the effects of policies that lead to technology utilisation. Some programs

were organised by Austria to provide teachers with courses on computer adoption to increase their skills [63]. It has been verified by Zain, Rose [62] that government policy has a significant effect on the individual technology adoption in an organisation. Purnomo and Kusnandar [64] reported that government policy has a direct effect on ICT and also determined that PU and PEOU mediate between government policy and ICT. Hence, this study hypothesises the following:

**H7a.** *Government policy has a significant effect on the perceived usefulness of LMS usage among university lecturers.*

**H7b.** *Government policy has a significant effect on the perceived ease of use of LMS usage among university lecturers.*

**H7c.** *Government policy has a significant indirect effect on LMS usage through perceived usefulness.*

**H7d.** *Government policy has a significant indirect effect on LMS usage through perceived ease of use.*

This study's proposed conceptual model integrates the TAM and TOE in order to accomplish the research objectives and test the presented hypotheses. Figure 1 present the proposed research model and illustrates the variables chosen from each model.

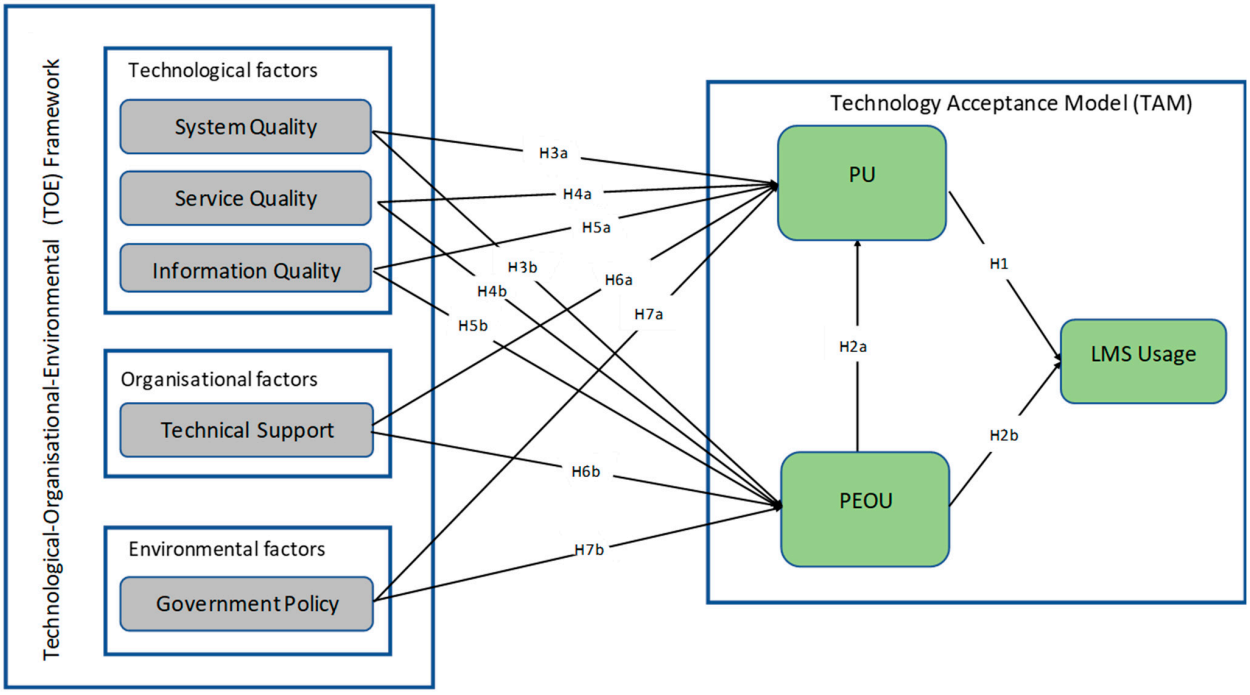


**Figure 1.** Proposed Conceptual Model.

## 3. Methodology

### *3.1. Demographic Characteristics of the Respondents*

The dataset used in this study is identical to that employed in our previous publication [12]. It comprises responses from academicians on LMS usage. The current study, however, diverges in its analytical focus, exploring different independent variables and employing distinct theoretical frameworks.

The demographic data of the respondents are shown in Table 1. Out of 393 respondents, 53.69% had a master's degree and 38.93% had a PhD. More than 75% of the respondents' academic rankings are either assistant lecturers or lecturers because most of the respondents are young as their age was between 31 and 45 years. Only 6% of the respondent were professors due to the limited number of professors in the Iraqi universities.

**Table 1.** Respondent demographic information.

| Characteristic | Frequency | Percentage |
|---|---|---|
| Gender | | |
| Male | 217 | 55.22 |
| Female | 176 | 44.78 |
| Age | | |
| 25–30 years | 22 | 5.60 |
| 31–35 years | 56 | 14.25 |
| 36–40 years | 103 | 26.21 |
| 41–45 years | 87 | 22.14 |
| 46–50 years | 51 | 12.98 |
| 51–55 years | 32 | 8.14 |
| 56–60 years | 22 | 5.60 |
| Over 60 years | 20 | 5.09 |
| Education | | |
| High Diploma | 29 | 7.38 |
| Master's Degree | 211 | 53.69 |
| PhD | 153 | 38.93 |
| Academic Ranking | | |
| Assistance Lecturer | 151 | 38.42 |
| Lecturer | 149 | 37.91 |
| Assistance Professor | 68 | 17.30 |
| Professor | 25 | 6.36 |

### *3.2. Measurement Instrument*

The current study aims to examine the factors influencing LMS usage in universities using an integration of TOE framework and TAM model. Following quantitative research approach, a set of questionnaires was prepared to collect data from academicians.

Constructs of the items have been identified based on the literature review and theoretical framework of prior studies. All items representing the constructs chosen for the proposed research model were used to create the questionnaire, which was developed using a survey research design. The survey consists of two sections. The first section concerns the demographical information of the academicians. In contrast, the second section concerns the LMS usage containing the items shown in Table 2. As part of the questionnaire provided to the respondents, a total of 36 items of all relevant constructs were developed. For the purposes of data collection, we measured constructs using a 5-point Likert scale, with 1 representing "strongly disagree" and 5 representing "strongly agree" [65]. The questionnaire comprised close-ended questions using English and was translated into the Kurdish language. The Kurdish version questionnaire was created using all the items representing the constructs selected for the proposed research model. The translation and meaning of the questions were reviewed by academic experts, experienced in the area of eLearning. Then, both the English and Kurdish versions were again piloted by 54 lecturers at the University of Kurdistan Hawler to ensure that the respondents would be able to understand the measures and provide appropriate responses to the questions.

**Table 2.** Measurement items.

| Constructs | Items | Sample of Measurement Item | Sources |
|---|---|---|---|
| System quality | SYSQ1 | LMS has a well-designed user interface. | Wang and Wang [24] |
| | SYSQ2 | LMS allows me to have control over my teaching activities. | |
| | SYSQ3 | LMS offers flexibility of time and place of use. | Pituch and Lee [66] |
| | SYSQ4 | LMS provides functions I need to do my teaching activities. | |
| | SYSQ5 | I can easily access the LMS anytime I need to use it. | |

**Table 2.** *Cont.*

| Constructs | Items | Sample of Measurement Item | Sources |
|---|---|---|---|
| Service quality | SERQ1 | Training on the operation of LMS is sufficient. | Wang and Wang [24] |
| | SERQ2 | I can communicate with the technicians through multiple channels when I encounter technical problems. | Ngai, Poon [28] |
| | SERQ3 | Employees of the information service department can quickly fix my technical problems. | |
| | SERQ4 | The training provided can enhance my ability to help in using LMS. | |
| | SERQ5 | In general, the university provides enough support to help in using LMS. | |
| Information quality | INFQ1 | LMS can provide me accurate information. | Wang and Wang [24] |
| | INFQ2 | LMS can provide me sufficient information to enable me to do my tasks. | Rai, Lang [67] |
| | INFQ3 | LMS can provide the precise information I need. | |
| | INFQ4 | LMS can provide helpful information regarding my tasks. | |
| | INFQ5 | I am satisfied with the accuracy of LMS. | |
| Technical support | TS1 | University offers good technical support. | Igbaria, Guimaraes [46] |
| | TS2 | A help desk is always available. | Alshammari, Ali [68] |
| | TS3 | Enquiries through the mobile phone can be done. | |
| | TS4 | Enquiries by email can be done. | |
| | TS5 | A person or group is available for assisting me with solving the problem. | |
| | TS6 | A clear technical manual (educational instruction) in software is available to help me know how to use Moodle. | |
| Government policy | GOVP1 | Government policy intended to promote my ability to use LMS platforms is effective. | Li, Wang [69] |
| | GOVP2 | Government policy intended to evaluate teaching quality affects me to use LMS. | Lai, Sun [70] |
| | GOVP3 | Government policy encourages me to use LMS in the teaching process. | |
| | GOVP4 | Government policy supports the use of LMS within the learning process. | |
| | GOVP5 | Government's investment in educational technology met the basic needs of teaching. | |
| Perceived usefulness | PU1 | Using LMS for work enables me to accomplish tasks more quickly. | Davis [13] |
| | PU2 | Using LMS for work improves my job performance. | |
| | PU3 | Using LMS for work increases my job productivity. | |
| | PU4 | Using LMS for work enhances my effectiveness. | |
| | PU5 | LMS for work is useful in my job. | |
| Perceived ease of use | PEOU1 | Learning how to use LMS is easy. | Davis [13] |
| | PEOU2 | My interaction with LMS is clear and understandable. | |
| | PEOU3 | I find LMS to be very flexible. | |
| | PEOU4 | I find it easy to get LMS to do the work I want it to do. | |
| | PEOU5 | Overall, I find that LMS is easy to use. | |
| LMS Usage | US1 | Currently, I use LMS in my teaching and learning process. | Davis [13] |
| | US2 | I use LMS more than any other educational technologies. | |
| | US3 | I use LMS to upload course materials. | |
| | US4 | I use assessment tools (quizzes or tests) inside LMS. | |
| | US5 | I use communicating tools (discussions) inside LMS. | |

### *3.3. Data Collection Process*

For data collection, a probability sampling technique was used in this study. Firstly, cluster sampling was used to select universities from the list of universities under the rule of the Ministry of Higher Education in the Kurdistan Region. After cluster sampling was completed in selecting the suitable sample frame for the study, random sampling was used to select respondents. The data were collected through hand-by-hand distribution among academicians. The data were collected from lecturers using Moodle as LMS in their teaching process. The researchers distributed 600 questionnaires, and 393 participants responded, producing a response rate of 65.5%. This response rate is adequate according to Babbie [71]. In total, 393 responses were considered useful and seen to meet the sample size requirement of building an adequate model [65]. The 393 samples obtained for data

collection depend on the confidence level of 95% and the margin of error 5%, which is appropriate in most quantitative research [71]. All data were screened by basic frequency distribution and descriptive statistics. Out-of-range or incorrectly coded values were immediately recognised. A frequency test was run on each variable to identify incorrect and missing values. Therefore, the data entry was performed correctly, without missing or incorrect values.

The lecturers were informed of the purpose and nature of the study and asked if they were willing to participate. Before completing the questionnaire, they were required to read and sign a letter assuring them that their participation was voluntary and that their answers would be kept confidential. Each participant signed a consent letter and was instructed to read the instructions and respond to the survey in accordance with the instructions. They were persuaded to clarify any ambiguous questionnaire items. Consequently, ethical considerations were adhered to stringently during data collection. The Kurdistan National Research Council Ethical Committee (KNRCEC) provided ethical approval to this study.

### *3.4. Data Analysis Plan*

This study used SmartPLS 4.0 software for data analysis. As this study is not based on a developing construct scale, it used a developed questionnaire from previous studies. Because of this, factor analysis and reliability tests were required to determine the likelihood of the questionnaire's effectiveness [72]. Exploratory and confirmatory factor analyses are required to check for new and adopted measures' validity [65]. For multivariate data analysis using Partial Least Square (PLS-SEM), also known as PLS path Modelling, statistical tools are often appropriate. PLS-SEM facilitates the development of hypotheses in exploratory research by focusing on the changes in the dependent variable during model examination [73]. According to Hair, Hult [74], when a researcher examines which independent variables have a high potential to predict the best outcome on a dependent variable or when the research objective is to determine a statistically significant predictor confirmation indicator, an exploratory instrument is used.

## 4. Data Analysis and Results

The procedure of data analysis was conducted in three stages. The first stage started by analysis of descriptive statistics of the respondents' demographic characteristics as shown in the Methodology section. In the second stage, the authors measured overall model fitness. The final stage of data analysis, followed by inferential statistics, started with evaluating the measurement model and then assessing structural modelling, including co-efficient determination ($R^2$) and effect size ($f^2$). Finally, the predictive relevance of the structural model was determined using $Q^2$.

### *4.1. Model Fit Indicators*

Before verifying the research model's reliability and validity, this study determined whether the research model was appropriate for the data it aimed to collect. This study used indices such as CMIN/d.f, RMSEA, CFI, AGFI, GFI, and TLI which are typically employed by many studies for suitability verification of their model as shown in Table 3. All values exceeded the recommended thresholds. The research model would therefore be suitable for testing the developed hypotheses.

**Table 3.** Measurement Model fit indices.

| Threshold Values | CMIN/d.f (<3) | RMSEA (<0.08) | CFI (>0.9) | AGFI (>0.8) | GFI (>0.9) | TLI (>0.9) |
|---|---|---|---|---|---|---|
| Structural Model Fit Indices | 1.94 | 0.054 | 0.935 | 0.853 | 0.915 | 0.931 |

### *4.2. Evaluation of the Measurement Model*

Prior to evaluating the measurement model, the loadings and significance of the indicators were evaluated. According to Hair, Hult [74], the outer loading of the indicator should be greater than 0.70. The loading between 0.4 and 0.7 should only be omitted if its omission improves the construct's consistency and reliability [75]. Accordingly, Table 4 displays the constructs and their accepted indicators. To evaluate the reliability of the reflective measurement model, the results of Cronbach's alpha, Rho-a, Composite Reliability, and the commonality of each construct were evaluated. The convergent validity was determined by calculating the Average Variance Extracted (AVE) and comparing it to the Convergent Validity. In addition, the divergent validity was assessed utilising the cross-loading test, the Fornell–Larcker criterion, and the Heterotrait–Monotrait test (HTMT). Lastly, the predictive value of the measurement model was evaluated by calculating the $Q^2$ index.

**Table 4.** Construct reliability and validity.

| Constructs | Items | Loadings | Cronbach's Alpha | Rho_A | Composite Reliability | AVE |
|---|---|---|---|---|---|---|
| System quality | SYSQ1 | 0.835 | 0.897 | 0.897 | 0.924 | 0.708 |
| | SYSQ2 | 0.872 | | | | |
| | SYSQ3 | 0.832 | | | | |
| | SYSQ4 | 0.844 | | | | |
| | SYSQ5 | 0.824 | | | | |
| Service quality | SERQ1 | 0.781 | 0.878 | 0.88 | 0.911 | 0.672 |
| | SERQ2 | 0.829 | | | | |
| | SERQ3 | 0.833 | | | | |
| | SERQ4 | 0.82 | | | | |
| | SERQ5 | 0.835 | | | | |
| Information quality | INFQ1 | 0.82 | 0.893 | 0.893 | 0.921 | 0.7 |
| | INFQ2 | 0.856 | | | | |
| | INFQ3 | 0.845 | | | | |
| | INFQ4 | 0.83 | | | | |
| | INFQ5 | 0.832 | | | | |
| Technical support | TS1 | 0.788 | 0.884 | 0.885 | 0.912 | 0.633 |
| | TS2 | 0.826 | | | | |
| | TS3 | 0.82 | | | | |
| | TS4 | 0.807 | | | | |
| | TS5 | 0.779 | | | | |
| | TS6 | 0.753 | | | | |
| Government policy | GOVP1 | 0.854 | 0.889 | 0.892 | 0.923 | 0.751 |
| | GOVP2 | 0.903 | | | | |
| | GOVP4 | 0.862 | | | | |
| | GOVP5 | 0.847 | | | | |
| Perceived usefulness | PU1 | 0.825 | 0.893 | 0.893 | 0.921 | 0.7 |
| | PU2 | 0.847 | | | | |
| | PU3 | 0.839 | | | | |
| | PU4 | 0.833 | | | | |
| | PU5 | 0.84 | | | | |
| Perceived ease of use | PEOU1 | 0.824 | 0.901 | 0.901 | 0.926 | 0.716 |
| | PEOU2 | 0.867 | | | | |
| | PEOU3 | 0.847 | | | | |
| | PEOU4 | 0.833 | | | | |
| | PEOU5 | 0.858 | | | | |

**Table 4.** *Cont.*

| Constructs | Items | Loadings | Cronbach's Alpha | Rho_A | Composite Reliability | AVE |
|---|---|---|---|---|---|---|
| LMS Usage | LMSU1 | 0.798 | 0.851 | 0.856 | 0.893 | 0.626 |
| | LMSU2 | 0.811 | | | | |
| | LMSU3 | 0.829 | | | | |
| | LMSU4 | 0.769 | | | | |
| | LMSU5 | 0.746 | | | | |

#### 4.2.1. Assessment of the Indicator Loading

Hair, Hult [74] state that the outer loadings of the indicator should exceed 0.7 thresholds. The removal of indicators with outer loadings between 0.4 and 0.7 should only be considered if doing so improves the CR and content validity of the constructs. The item codes are displayed in Figure 2. The researchers omitted GOVP3 as a result of this item's outer loadings and the effect of its omission on the consistency and reliability of each construct. Therefore, according to Table 4, the accepted items are included in the evaluation and analysis.

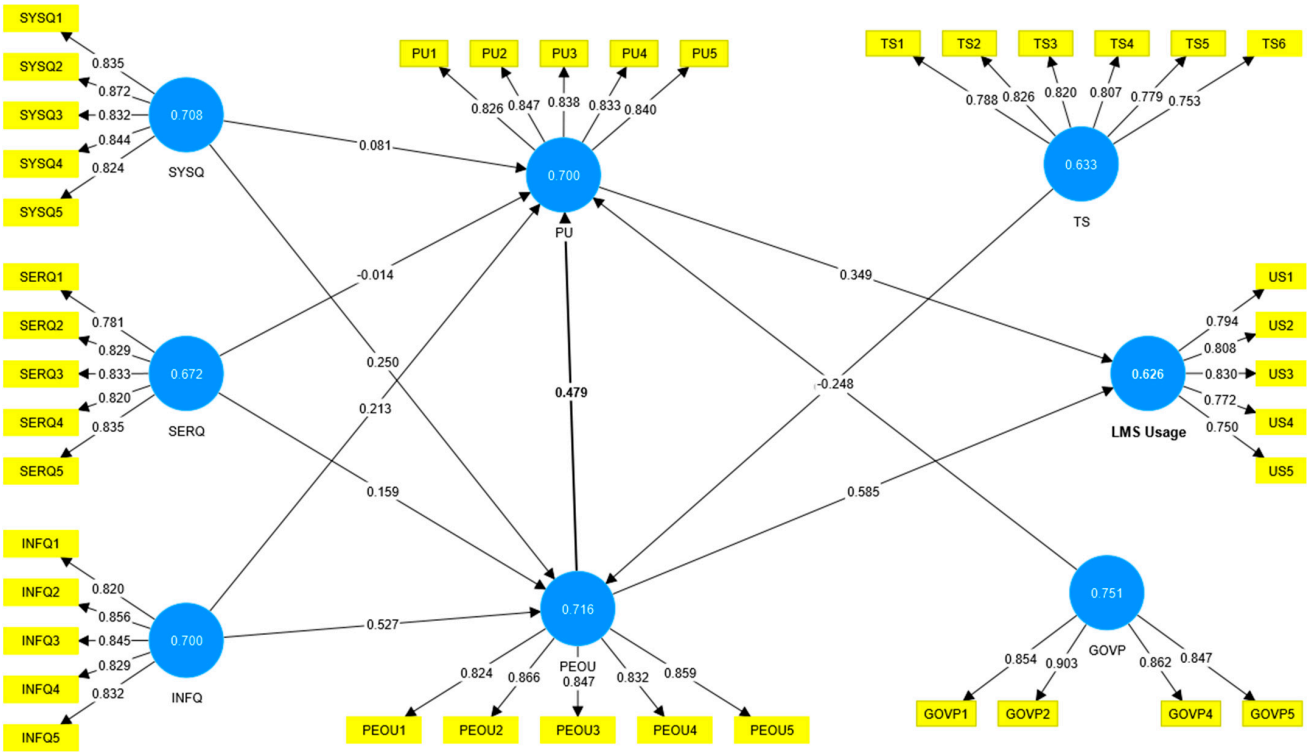


**Figure 2.** PLS Algorithm for confirmatory factor analysis.

#### 4.2.2. Cronbach Alpha

According to Hair, Ringle [76], Cronbach's alpha provides an estimate of reliability based on the intercorrelations of indicators. According to the criteria established by Haenlein and Kaplan [77], Cronbach's alpha values above 0.7 are acceptable. As shown in Table 4, each Cronbach's alpha value is greater than 0.7, confirming the internal consistency and reliability of the measurement model based on this criterion.

#### 4.2.3. Composite Reliability (CR)

Due to the limitations of Cronbach's alpha, it is recommended to employ an alternative criterion, such as CR, which is measured for various outer loadings of the indicators. For CR, values greater than 0.7 are recommended [74]. According to Table 4, the measurement model's reliability is also confirmed when CR is considered.

#### 4.2.4. Average Variance Extracted (AVE)

AVE is the total mean of each indicator's squared loading [74]. The minimum acceptable value for AVE is 0.5 [75]. As shown in Table 4, the AVE for every construct is greater than 0.5. In consequence, the accuracy of the measurement model based on this index is confirmed. Comparing CR to AVE is another test used to determine convergent validity; for each construct, CR values should be greater than AVE values [74]. This is permitted for all structures (see Table 4).

#### 4.2.5. Cross-Loading of Indicators

Evidence for the discriminant validity of the constructs is provided by cross-loadings and the Fornell–Larcker criterion [78]. Each indicator must have outer loadings that are larger than its cross-loadings or correlation with other constructs [78]. Table 5 shows that the outer loadings of all indicators are greater than 0.1, indicating low to moderate levels of correlation with other constructs. The convergence validity is therefore confirmed.

**Table 5.** Cross loading.

| Items | Government Policy | Information Quality | LMS Usage | Perceived Ease of Use | Perceived Usefulness | Service Quality | System Quality | Technical Support |
|---|---|---|---|---|---|---|---|---|
| GOVP1 | 0.854 | −0.456 | −0.447 | −0.47 | −0.558 | −0.476 | −0.48 | −0.481 |
| GOVP2 | 0.903 | −0.476 | −0.457 | −0.463 | −0.559 | −0.493 | −0.408 | −0.42 |
| GOVP4 | 0.862 | −0.415 | −0.384 | −0.369 | −0.522 | −0.461 | −0.359 | −0.344 |
| GOVP5 | 0.847 | −0.403 | −0.379 | −0.37 | −0.496 | −0.454 | −0.315 | −0.33 |
| INFQ1 | −0.396 | 0.82 | 0.64 | 0.692 | 0.608 | 0.557 | 0.555 | 0.494 |
| INFQ2 | −0.483 | 0.856 | 0.699 | 0.736 | 0.667 | 0.6 | 0.574 | 0.498 |
| INFQ3 | −0.395 | 0.845 | 0.687 | 0.676 | 0.653 | 0.571 | 0.525 | 0.484 |
| INFQ4 | −0.399 | 0.829 | 0.656 | 0.674 | 0.671 | 0.519 | 0.531 | 0.471 |
| INFQ5 | −0.442 | 0.832 | 0.722 | 0.726 | 0.678 | 0.608 | 0.584 | 0.535 |
| PEOU1 | −0.451 | 0.697 | 0.701 | 0.824 | 0.688 | 0.567 | 0.626 | 0.547 |
| PEOU2 | −0.451 | 0.724 | 0.765 | 0.866 | 0.711 | 0.627 | 0.633 | 0.553 |
| PEOU3 | −0.35 | 0.707 | 0.738 | 0.847 | 0.693 | 0.63 | 0.604 | 0.549 |
| PEOU4 | −0.372 | 0.699 | 0.739 | 0.832 | 0.698 | 0.566 | 0.62 | 0.501 |
| PEOU5 | −0.427 | 0.719 | 0.754 | 0.859 | 0.71 | 0.646 | 0.655 | 0.563 |
| PU1 | −0.546 | 0.651 | 0.677 | 0.701 | 0.826 | 0.552 | 0.596 | 0.539 |
| PU2 | −0.581 | 0.676 | 0.709 | 0.706 | 0.847 | 0.561 | 0.577 | 0.528 |
| PU3 | −0.454 | 0.649 | 0.709 | 0.682 | 0.838 | 0.559 | 0.529 | 0.516 |
| PU4 | −0.481 | 0.644 | 0.66 | 0.655 | 0.833 | 0.507 | 0.54 | 0.479 |
| PU5 | −0.514 | 0.658 | 0.73 | 0.715 | 0.84 | 0.589 | 0.602 | 0.551 |
| SERQ1 | −0.456 | 0.506 | 0.534 | 0.548 | 0.511 | 0.781 | 0.561 | 0.526 |
| SERQ2 | −0.497 | 0.53 | 0.539 | 0.556 | 0.531 | 0.829 | 0.504 | 0.524 |
| SERQ3 | −0.411 | 0.569 | 0.582 | 0.594 | 0.549 | 0.833 | 0.484 | 0.501 |
| SERQ4 | −0.431 | 0.576 | 0.549 | 0.598 | 0.54 | 0.82 | 0.519 | 0.476 |
| SERQ5 | −0.44 | 0.614 | 0.577 | 0.643 | 0.58 | 0.835 | 0.555 | 0.58 |
| SYSQ1 | −0.434 | 0.573 | 0.57 | 0.633 | 0.582 | 0.537 | 0.835 | 0.584 |
| SYSQ2 | −0.419 | 0.562 | 0.582 | 0.618 | 0.574 | 0.535 | 0.872 | 0.567 |
| SYSQ3 | −0.297 | 0.541 | 0.566 | 0.608 | 0.546 | 0.534 | 0.832 | 0.532 |
| SYSQ4 | −0.4 | 0.539 | 0.583 | 0.612 | 0.571 | 0.522 | 0.844 | 0.543 |
| SYSQ5 | −0.354 | 0.569 | 0.588 | 0.648 | 0.589 | 0.56 | 0.824 | 0.554 |
| TS1 | −0.395 | 0.471 | 0.45 | 0.498 | 0.492 | 0.515 | 0.498 | 0.788 |
| TS2 | −0.352 | 0.47 | 0.487 | 0.501 | 0.488 | 0.498 | 0.52 | 0.826 |
| TS3 | −0.381 | 0.47 | 0.495 | 0.514 | 0.503 | 0.521 | 0.536 | 0.82 |
| TS4 | −0.356 | 0.512 | 0.53 | 0.557 | 0.539 | 0.516 | 0.555 | 0.807 |
| TS5 | −0.343 | 0.458 | 0.492 | 0.508 | 0.5 | 0.462 | 0.541 | 0.779 |
| TS6 | −0.359 | 0.451 | 0.48 | 0.481 | 0.458 | 0.529 | 0.502 | 0.753 |
| LMSU1 | −0.387 | 0.649 | 0.794 | 0.785 | 0.651 | 0.592 | 0.607 | 0.547 |
| LMSU2 | −0.398 | 0.678 | 0.808 | 0.795 | 0.678 | 0.6 | 0.582 | 0.527 |
| LMSU3 | −0.332 | 0.643 | 0.83 | 0.681 | 0.671 | 0.551 | 0.51 | 0.481 |
| LMSU4 | −0.379 | 0.636 | 0.772 | 0.605 | 0.656 | 0.455 | 0.522 | 0.418 |
| LMSU5 | −0.418 | 0.614 | 0.75 | 0.563 | 0.644 | 0.468 | 0.485 | 0.449 |

#### 4.2.6. The Fornell–Larker Criterion

The Fornell–Larker criterion for evaluating convergent validity is also commonly cited in the literature. The square root of the AVE values for each structure is calculated and stored in a matrix that is generated by this test [74]. Each construct's AVE square root must be higher than its correlation with other constructs, according to the evaluation method used in this test [79]. As shown in Table 6, the Fornell–Larker matrix confirms convergent validity. According to Table 4, the major elements within the diagonals of the matrix represent the square roots of the extracted average variance. All AVEs square measurements are significantly greater than the other correlation coefficients, indicating the construct has discriminant validity.

**Table 6.** Discriminant validity.

| Items | Government Policy | Information Quality | LMS Usage | Perceived Ease of Use | Perceived Usefulness | Service Quality | System Quality | Technical Support |
|---|---|---|---|---|---|---|---|---|
| Government policy | 0.867 | | | | | | | |
| Information quality | −0.506 | 0.837 | | | | | | |
| LMS Usage | −0.482 | 0.815 | 0.791 | | | | | |
| Perceived ease of use | −0.485 | 0.838 | 0.874 | 0.846 | | | | |
| Perceived usefulness | −0.617 | 0.784 | 0.834 | 0.828 | 0.837 | | | |
| Service quality | −0.544 | 0.684 | 0.679 | 0.718 | 0.662 | 0.82 | | |
| System quality | −0.454 | 0.662 | 0.687 | 0.742 | 0.681 | 0.639 | 0.842 | |
| Technical support | −0.457 | 0.594 | 0.616 | 0.642 | 0.626 | 0.637 | 0.661 | 0.796 |

### *4.3. Structural Model Test*

Significant tests of hypotheses were conducted to evaluate the structural model's strength and direction after the measurement model's validity and reliability had already been established. After that, metrics for both structural model quality and model fit were calculated.

#### 4.3.1. Path Coefficients

An explanation for the strength of the hypotheses can be derived from a coefficient known as the path coefficient, which is typically a positive or negative number. Each hypothesis' significance and associated path coefficients are listed in Table 7.

**Table 7.** Path coefficient and t-statistics.

| Hypothesised Path | Standardised Beta | Confidence Interval 95% Bias Corrected | | t-Statistics | *p*-Values | Result |
|---|---|---|---|---|---|---|
| | | LL | UL | | | |
| H1: Perceived usefulness -> LMS Usage | 0.345 | 0.191 | 0.516 | 4.113 | 0.000 | Supported |
| H2a: Perceived ease of use -> Perceived usefulness | 0.469 | 0.274 | 0.636 | 4.91 | 0.000 | Supported |
| H2b: Perceived ease of use -> LMS Usage | 0.59 | 0.420 | 0.740 | 7.252 | 0.000 | Supported |
| H3a: System quality -> Perceived usefulness | 0.056 | −0.071 | 0.183 | 0.844 | 0.199 | Not Supported |
| H3b: System quality -> Perceived ease of use | 0.251 | 0.144 | 0.364 | 4.58 | 0.000 | Supported |
| H4a: Service quality -> Perceived usefulness | −0.031 | −0.150 | 0.098 | 0.482 | 0.315 | Not Supported |
| H4b: Service quality -> Perceived ease of use | 0.163 | 0.051 | 0.287 | 2.664 | 0.004 | Supported |
| H5a: Information quality -> Perceived usefulness | 0.21 | 0.063 | 0.366 | 2.637 | 0.004 | Supported |
| H5b: Information quality -> Perceived ease of use | 0.53 | 0.364 | 0.701 | 6.108 | 0.000 | Supported |
| H6a: Technical support -> Perceived usefulness | 0.072 | −0.022 | 0.179 | 1.421 | 0.078 | Not Supported |

**Table 7.** *Cont.*

| Hypothesised Path | Standardised Beta | Confidence Interval 95% Bias Corrected | | t-Statistics | *p*-Values | Result |
|---|---|---|---|---|---|---|
| | | LL | UL | | | |
| H6b: Technical support -> Perceived ease of use | 0.064 | −0.016 | 0.155 | 1.438 | 0.075 | Not Supported |
| H7a: Government policy -> Perceived usefulness | −0.241 | −0.372 | −0.146 | 4.332 | 0.000 | Supported |
| H7b: Government policy -> Perceived ease of use | 0.015 | −0.082 | 0.120 | 0.289 | 0.386 | Not Supported |

Table 7 indicates that eight direct hypotheses were significant out of thirteen hypotheses as their *p* values are less than 0.05, which is also depicted in Figure 3. The highly significant path (t = 7.252) was detected between PEOU and LMS Usage (β = 0.59 or 59%), and the second highly significant path (t = 6.108) was between INFQ and POEU (β = 0.53 or 53%). The other significant paths, such as GOVP -> PU, INFQ -> PU, SYQ -> PEOU, SERQ -> POEU, PEOU -> PU and PU -> LMS Usage, are significant because the *p*-values of those paths are less than 0.05, and the t-values are higher than 1.96. However, the paths SYSQ -> PU, SERQ -> PU, TS -> PU, TS -> PEOU, and GOVP -> PEOU do not have any significant relationships as their *p*-values are higher than 0.05. Thus, these proposed hypotheses were revealed as not supported.

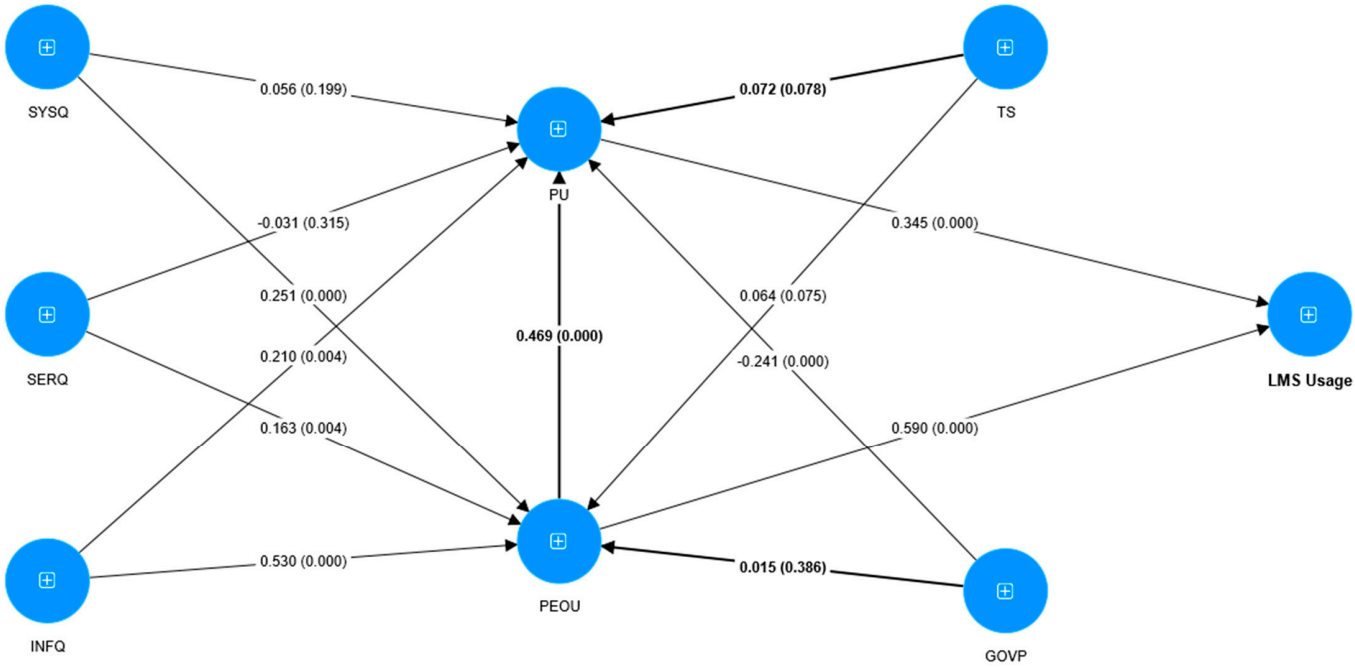


**Figure 3.** Structural model result.

4.3.2. The Coefficient of Determination ($R^2$)

The coefficient of determination quantifies the predictive ability of the model and specifies the proportion of the dependent variable's variance that can be predicted using the independent variables. According to Chin [73], $R^2$ values of 0.67, 0.333, and 0.190 were considered to have substantial, moderate, and weak explanatory power, respectively. It has also been suggested that $R^2$ values of 0.75, 0.5, and 0.25 represent a substantial, moderate, and weak endogenous latent construct, respectively. Table 8 contains the estimates for the R-squared measures. According to Chin [73], the $R^2$ value of 0.804 for the LMS application demonstrates a substantial predictive capacity. In addition, the $R^2$ value of 0.781% for the perceived ease of use demonstrates the model's substantial ability to predict this construct.

Lastly, the $R^2$ value of 0.762 for predicting perceived usefulness indicates that the model predicting this construct has substantial explanatory power.

**Table 8.** R-Squared index.

| | R-Square | R-Square Adjusted |
|---|---|---|
| LMS Usage | 0.804 | 0.803 |
| PEOU | 0.781 | 0.779 |
| PU | 0.762 | 0.759 |

#### 4.3.3. Predictive Relevance of the Structural Model

The $Q^2$ index presented by Geisser [80] evaluates the structural model's quality. This index is computed using the Blindfolding method. Values greater than 0.02, 0.15, and 0.35 indicate the model's poor, average, and strong ability to predict the endogenous construct, respectively. According to Table 9, all $Q^2$ indicators were reported to be greater than 0.35, thereby approving the structural model's quality.

**Table 9.** Predictive relevance of the structural model.

| Constructs | $Q^2$ |
|---|---|
| LMS Usage | 0.703 |
| PEOU | 0.765 |
| PU | 0.697 |

### *4.4. Mediation Analysis*

The bootstrapping technique was used for the mediating analysis in this study, as suggested by Hair, Black [65]. Bootstrapping is a nonparametric resampling process that has proven itself as a robust technique for investigating mediation effects [81,82].

Several scholars have suggested that the direct effect may become unimportant [81]. This is because a substantial direct association may go unnoticed due to various circumstances, such as small sample size or insufficient predictive power to reveal the current effect. As a result, the most important part of observing the indirect effect is the mediation analysis [83].

Table 10 illustrates the bootstrapping results for the indirect effect, where the bootstrapping analysis was managed to illustrate the indirect effect of PEOU and PU. The effects of independent variables are dependent variables through PEOU and PU, where the mediation effects were statistically significant.

**Table 10.** Mediation test of TAM variables.

| | Hypothesised Path | Original Sample (O) | Confidence Interval 95% Bias Corrected | | t-Statistics | *p*-Values | Result |
|---|---|---|---|---|---|---|---|
| | | | LL | UL | | | |
| Mediation effect of perceived usefulness | H3c: System quality -> Perceived usefulness -> LMS Usage | 0.019 | −0.015 | 0.026 | 0.846 | 0.199 | Not supported |
| | H4c: Service quality -> Perceived usefulness -> LMS Usage | −0.011 | −0.016 | 0.030 | 0.443 | 0.329 | Not supported |
| | H5c: Information quality -> Perceived usefulness -> LMS Usage | 0.072 | 0.008 | 0.059 | 1.863 | 0.031 | Supported |
| | H6c: Technical Support -> Perceived usefulness -> LMS Usage | 0.025 | −0.011 | 0.026 | 1.349 | 0.089 | Not supported |
| | H7c: Government policy -> Perceived usefulness -> LMS Usage | −0.083 | 0.006 | 0.040 | 3.76 | 0 | Supported |

**Table 10.** *Cont.*

| | Hypothesised Path | Original Sample (O) | Confidence Interval 95% Bias Corrected | | t-Statistics | *p*-Values | Result |
|---|---|---|---|---|---|---|---|
| | | | LL | UL | | | |
| Mediation effect of perceived ease of use | H3d: System quality -> Perceived ease of use -> LMS Usage | 0.148 | 0.069 | 0.192 | 4.156 | 0 | Supported |
| | H4d: Service quality -> Perceived ease of use -> LMS Usage | 0.096 | −0.021 | 0.117 | 2.671 | 0.004 | Supported |
| | H5d: Information quality -> Perceived ease of use -> LMS Usage | 0.313 | 0.072 | 0.264 | 4.085 | 0 | Supported |
| | H6d: Technical Support -> Perceived ease of use -> LMS Usage | 0.038 | 0.033 | 0.156 | 1.443 | 0.075 | Not supported |
| | H7d: Government policy -> Perceived ease of use -> LMS Usage | 0.009 | −0.050 | 0.051 | 0.289 | 0.386 | Not supported |

The results of the mediation analysis are presented in Table 10, which reveals that among the five proposed mediating hypotheses through PU where two hypotheses were determined to be statistically significant, three were not supported. The supported mediating paths, such as INFQ -> PU -> LMS Usage and GOVP -> PU -> LMS Usage, were revealed as statistically significant as their *p*-values are less than 0.05, and the value of the confidence interval's lower limits (LL) and upper limits (UL) are positive, meaning they have no zeros in between which confirms mediating effects on those relationships. This means that Information Quality and Government Policy have an indirect relationship with LMS usage through Perceived Usefulness. However, paths such as SYSQ -> PU -> LMS Usage, SERQ -> PU -> LMS Usage, and TS -> PU -> LMS Usage were not statistically significant as their *p*-values are higher than 0.05, and the values of LL are negative, and the values of UL are positive, meaning there are zeros in between, which confirms no mediating effects on those relationships. That indicates that System Quality, Service Quality, and Technical Support do not have a significant indirect relationship with LMS usage through Perceived Usefulness. Similarly, the effects of independent variables are dependent variables through PEOU, where the mediation effects were confirmed to be statistically significant.

The mediation analysis results are presented in Table 10, where five mediating hypotheses through PEOU were proposed. Among the five proposed mediating hypotheses through PEOU, three hypotheses, SYSQ -> PEOU -> LMS Usage, SERQ -> PEOU -> LMS Usage, and INFQ -> PEOU -> LMS Usage, were revealed as statistically significant as their *p*-values are less than 0.05, and the values of LL and UL are positive, meaning there were no zeros in between, which confirms mediating effects on those relationships. This means that System Quality, Service Quality, and Information Quality have an indirect relationship with LMS usage through Perceived Ease of Use. However, the paths such as TS -> PEOU -> LMS Usage and GOVP -> PEOU -> LMS Usage were not statistically significant as their *p* values are higher than 0.05, and the values of LL are negative, and the values of UL are positive, meaning zeros exist in between, which confirms no significant mediating effects on those mediating paths. This indicates that Government Policy and Technical Support do not have a significant indirect relationship with LMS usage through Perceived Usefulness, according to the result provided in Table 10.

## 5. Discussion

This study extends the findings of our previous research by examining additional factors influencing LMS usage. Whereas our initial study centered on pedagogical beliefs, this study provides insights into the role of system service and information quality, technical support, and government policy. By addressing these different aspects, we offer a more comprehensive understanding of the determinants of LMS usage.

The result shows that system quality did not significantly correlate with perceived usefulness, having resulted with a standard beta value of 0.056 at a t-value of 0.844. That is why the H3a hypothesis is not supported. The finding of this study is inconsistent with most previous studies (e.g., Cheng, Chen [84]; Lwoga [85]. However, this finding was consistent with those of Motaghian, Hassanzadeh [26], Sharma, Gaur [55], and Wang and Wang [24]. The system quality's impact might be considered useful during early implementation but will decrease over time. Since PU depends on the LMS system's output quality, the lecturers must gain useful information from LMS systems. System quality showed a significant positive relationship with PEOU with a standard beta value of 0.251 and a t-value of 4.58, hence this hypothesis is supported. A similar finding was also achieved by Alshurideh, Al Kurdi [54], who determined that system quality is significantly related to ease of use. Previous studies also determined that system quality had significant positive effects on the PEOU of faculty members' LMS utilisation [18,50,55,86].

The service quality had an insignificant relationship with PU, resulting in a standard beta value of −0.031 and a t-value of 0.482. However, it had a significant relationship with perceived ease of use, with a standard beta value of 0.163 and a t-value of 2.664. This finding might be due to the logical prediction that most study participants had enough experience in utilising the system and leading them to consider service quality as a significant factor in predicting their perceived usefulness and ease of use. Moreover, it can be supposed that a few technical problems may occur during LMS usage because professional eLearning industries produce the system. In addition, the result may be explained by a lack of connection between the technical support unit and lecturers who participated in the study, making them unaware of the importance of the system's service quality. However, the findings of previous studies have shown that service quality is a critical factor in predicting eLearning acceptance [24,45,54,87]. The universities in the Kurdistan Region Government need to develop LMS services to enhance lecturers' system usage and to help the lecturers spend less time and effort learning and using their LMS [88]. The study results partially align with those of Ghazal, Aldowah [89], who determined that service quality is insignificantly related to usefulness and significantly related to ease of use and usefulness. In addition, the studies by Lwoga [85] and Al-Mamary [90], which tested the relationship between service quality and perceived ease of use, determined that this relationship was insignificant.

Information quality showed a strong positive relationship with PU and PEOU with a standard beta value of 0.21 and t-value of 2.637, and a beta value of 0.53 and t-value of 6.108, respectively. Many scholars agreed with this finding, stating that information quality is recognised as one of the most critical factors influencing the PU and PEOU of information when it is utilised to make decisions [47,50,54,55].

The findings of this study show that the relationship between technical support and perceived usefulness and perceived ease of use is insignificant with a standard beta value of 0.072 and t-value of 1.421, and a beta value of 0.064 and t-value of 1.438, respectively. The result of this study is quite different from the findings of the previous studies [53,57] and inconsistent with the findings of several other studies [28,57,91]. However, it is consistent with the findings of Kurdi, Alshurideh [53] and Son, Park [92].

These findings are similar to what has been determined by Baleghi-Zadeh, Ayub [60], who revealed that technical support had a significant positive relationship with perceived ease of use but not with perceived usefulness. However, the results are quite contrary to those of Abbad, Morris [93], who revealed that technical support had a significant effect on perceived usefulness but not on perceived ease of use.

In practice, the findings indicate that the better the technical support and assistance provided to lecturers to help them solve technical issues, the more likely it will be that lecturers find LMS usage easy. Universities thus need to have a technical support unit for the use of LMS in order to support lecturers and enhance LMS usage motivation. The insignificant result of technical support among the respondents indicates that they did not have enough support to continue using LMS even after the pandemic.

The results of this study show that government policy has a significant positive relationship with perceived usefulness with a standard beta value of −0.241 and t-value of 4.332. Therefore, the H7a hypothesis is accepted. This study's finding is consistent with that of Purnomo and Kusnandar [64], who determined that government policy significantly influences ICT acceptance. Haryanto, Gandhi [94] reported similar results in their empirical study on electronic signature utilisation. However, its relationship with perceived ease of use was insignificant, with a beta value of 0.015 and a t-value of 0.289. This finding is inconsistent with that of Li, Wang [69]. It can be supposed that the Iraqi policy affected lecturers' feelings mainly by influencing perceived usefulness, which further impacted their perceived ease of use of the technology.

The result can be interpreted as showing that lack of government policy and standards is considered as a critical factor influencing LMS usage. It is the responsibility of the Kurdistan Region Government to work on strong policies that encourage integrating technologies within teaching practice. The result of this study corroborates the previous literature affirming that government can act as an accelerator to develop and spread LMS adoption among lecturers by enforcing legislation and coordinating actions [95].

There were a few studies which also determined the strongest relationships between TAM constructs [17,96,97]. Because of this, the finding of this research is consistent with the prevalent school of thought, which is that the strongest relationship can be detected between perceived usefulness, ease of use, and LMS utilisation.

Previous studies have confirmed a mediation role of perceived ease of use and perceived usefulness between predicted external factors of TAM and actual technology usage. However, in the present study, five out of ten hypotheses related to mediation constructs were rejected. Those hypotheses are H3c, H4c, H6c, H6d, and H7d. In this case, it can be due to the direct relationship between the predicted external factor and the mediators. It can be predicted that if the result for a direct relationship between independent and dependent variables is insignificant, the mediation relationship would also be insignificant, hence the finding is that those hypothesises are not supported.

All the other hypothesises that tested the mediation relationships between exogenous variables and LMS were accepted. Those hypotheses are H5c, H7c, H3d, H4d, and H5d. Their mediation was strongly supported by significant results in the present study, and the results are supported by previous empirical studies [8,52,98,99].

### *5.1. Theoretical Contributions*

Although many scholars have explored technology usage in many developed countries, the researchers argue that just a few studies about technology have been conducted in Arab countries, and none were conducted in the Kurdistan Region of Iraq. Although some studies on technology adoption were carried out in the Kurdistan Region, they concerned only personal attempts to implement technology into teaching and training [59,100]. There were no comprehensive studies about LMS usage or the critical factors influencing LMS usage in the Kurdistan Region. This absence of actual studies and research on LMS usage has resulted in little insight into the user attitudes related to LMS. Thus, the findings of this research added to the body of knowledge and literature by reviewing the literature on LMS acceptability and adding to the body of knowledge on technology usage in Arab nations.

The findings of this study provided a novel contribution to examining the critical factors that would influence LMS usage in the Kurdistan Region. Aside from the Kurdistan Region of Iraq, developing countries with similar cultural and contextual factors may benefit from these findings. In addition, several of these findings were unique to the Kurdistan Region; for example, government policy and technical support findings. In addition, these findings can also be used to conduct further research in different contexts.

The current research combines the TAM and TOE frameworks in order to carry out an in-depth investigation into the application of the LMS. On the other hand, the authors did not determine that this integration can provide a theoretical model in the Arab literature that is based on the PLS-SEM.

This study helped illustrate the basic assumption of the TAM, which states that PU and PEOU can predict user acceptance of any technology [22]. According to the results, PU and PEOU had significant relationships with LMS use among lecturers in the Kurdistan Region.

Overall, this study developed a holistic framework where the framework of Tornatzky and Fleischer [37] and TAM model of Davis [13] explained the LMS usage among university lecturers in the Kurdistan Region of Iraq to provide a better understanding of these factors and the potential relationships between them.

### *5.2. Practical Contributions*

This study suggests that policymakers in higher education must assess the acceptance and usage of an LMS among lecturers. This is an opportunity for policymakers in higher education to revise and optimise policies on LMS use in universities. Because the implementation of an LMS is one way of innovating in education, it requires additional support from decision- and policymakers, especially for regional implementation in all universities. Based on the findings of this study, university leaders should ensure that adequate technical support is provided to lecturers on effective and efficient use of an LMS. As instructors' communication and responses via the LMS encourage students to use it, this can further the students' trust and belief that their instructors are knowledgeable in using the LMS. However, this also implies that instructors must have adequate technical support and training from the LMS software company to be well-orientated to the LMS platform. Lastly, technology acceptance profiles in university teaching staff are also evaluating their potential for teaching their students using an LMS.

## 6. Conclusions

The scope of the study was to use the PLS-SEM technique to determine the significant effect of factors affecting LMS usage among university lecturers in the Kurdistan Region of Iraq. To identify the antecedents, the study successfully integrated TAM and TOE. It extended TAM using a set of TOE variables relevant to LMS usage as an external variable to TAM, i.e., system quality, service quality, information quality, technical support and government policy, which have a direct effect on either of the two constructs of TAM or both and indirect effect on LMS usage.

The focus of this study was limited to the investigation of the three original constructs of TAM (perceived usefulness, perceived ease of use, and actual use) as influential variables of LMS usage. Future studies could explore and analyse all constructs of TAM which may influence the utilisation of LMS to provide a complete picture. Moreover, future research may use different factors from various theories, such as the unified theory of acceptance and use of technology, planned behaviour theory, and diffusion of innovation theory. All these are considered behavioural theories to determine technology usage.

The findings revealed that 80% (248 out of 393) of the instructors did not use LMS for student assessment. Further studies are required to determine the reasons behind so few lecturers using LMS features in relation to student assessment. Furthermore, the vast majority of the instructors use limited features of LMS. Further research is required to investigate the reasons behind the instructors not using the advanced features of LMS. The use of more features of LMS could positively impact learner outcomes.

This study recommends for future research to explore environmental factors and obtain results that indicate the university effect among different kinds of universities. In addition, future research could use a qualitative research design involving interviews, focus groups, and open-ended survey questions to better understand the main factors affecting lecturers' LMS usage. Although this study was conducted among lecturers only, it is recommended for future studies to collect data from two study populations, lecturers and students.

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