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Adoption and Use of Learning Management Systems in Education: The Role of Playfulness and Self-Management

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Abstract: This article investigates the factors affecting primary and secondary education teachers' behavioral intention to adopt learning management systems (LMSs). Information technology (IT) innovations have the power to change the way we work, educate, learn, and basically the way we live. The effect of IT innovations on education makes it critical to understand the current usage situation of LMSs and the factors affecting their adoption by teachers. The unified theory of acceptance and use of technology (UTAUT) was extended with factors from education and game-based learning literature. In order to see the effect of individual- and organizational-level characteristics, multi-group structural equation modeling (SEM) analysis was conducted and discrepancies in relationships were reported. Evaluation of users and non-users and teachers of different fields were also compared to each other. The findings of this study not only contribute to theory through the development and testing of a thorough model relating technology features and individual characteristics to behavioral intention to use, but also offer strong implications for practitioners who would like to increase LMS usage and create a more effective learning environment.

Keywords: learning management systems; technology acceptance; technology in education

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1. Introduction

A learning management system (LMS) is a software application that helps in administering, documenting, tracking, reporting, and delivering educational courses or training programs. LMSs started to be widely used in schools around Turkey. LMSs dramatically change methods of instruction for the teaching staff. LMSs not only form the foundation of distance education, they are also used heavily to support traditional face-to-face teaching at universities in a blended learning setting [1]. Online course offerings continue to increase. Teaching, designing, and developing online courses requires extensive faculty development [2]. Many faculty members are not motivated to teach their classes using the support of an LMS for a variety of reasons [2].

In addition to in universities, LMSs are widely used in primary and secondary education in Turkey. The classroom environment has changed radically in the last decade. To achieve an effective learning environment in the classroom, teachers started to implement digital tools. Since each and every student needs unique personalized education, varied assessment tools, and different success criteria, continuous learning in and out of the classroom is in the teachers' agenda. Learning technologies help teachers and students to achieve these new goals. The classroom is no longer the only place where learning happens. As has been observed lately, online teaching and learning has become a phenomenon and many believe that e-learning can be the next revolutionary change in education. E-learning is a way of learning supported by information communication technologies (ICT) that make it possible to deliver education and training to anyone, anytime, and anywhere.

With the advancement of technology in general, LMS applications are increasingly becoming the preferred method for learning among students, teachers, and others. LMS applications enable students and teachers to benefit from today's technology in their learning and teaching process. Defining the factors affecting adoption of LMS applications is important for future LMS design and educational strategy development and management.

In Turkey, primary education covers the education and teaching directed to children aged between 6 and 14. Primary education institutions are schools that provide eight years of uninterrupted education where the first four years of primary school are referred to as primary school (first level) and the second four years of primary education are referred to as middle school (second level). Turkish, mathematics, science, social studies, and foreign language are covered during second level of primary school. High school education is also four years long and covers the education and teaching directed to children aged 15 to 19 years old in Turkey. There are different types of high schools, such as Anatolian (regular) high schools, science- and technology-focused high schools, vocational highs schools, military high schools, etc. Teachers use LMS applications in teaching during classes such as conducting quizzes, watching videos, and more, and to give assignments to students. In addition, LMSs are used to communicate with parents and kids, to store and organize course material, and to keep track of students' exam and project scores. Content for both regular courses and exam preparation are used in LMSs by teachers and students. However, how effectively or frequently current LMS applications in the market are used in schools and what the teachers' perceptions on LMS usage are need a detailed analysis.

As explained above, e-learning and hence LMSs have become widely acknowledged and used in primary and secondary (high school) education institutes in Turkey. However, as far as the understanding of LMS adoption in primary and secondary education is concerned, it appears that there are few research efforts focused on the antecedents for explaining users' adoption of the LMS, which is an important topic in today's education system.

Since LMSs have become promising technological tools in today's education, antecedents of the adoption and use of these educational technologies should be explored from the consumer behavior perspective. Understanding the factors affecting users' perceptions that affect their intentions to use these technologies will help developers in designing features and will support education managers to better plan the organization of them, which will increase usage. The findings will also help both technology developers and the education institution managers in building strategies to increase adoption of LMSs among educators to increase efficiency in their organizations. Most importantly, these findings will lead educators to have effective control over administrative and communicative tasks and course content management. As a result, the findings will help students have a better and more fun learning environment.

Considering the primary and secondary schools in Turkey and in terms of the scale items being used in the model, this paper presents a unique contribution to the literature in terms of providing insights to future scholars in the same area or school officials who want to motivate their teachers to use LMS systems more effectively. In order to promote the use of LMS systems among faculty, administrators may wish to use the results of the study as they are in the decision-making process of buying new software, or modify existing software in terms of the following attributes:

- How much gamification and how many playful elements should be available in the LMS?
- How much should the LMS allow the instructors or students to manage the learning programs at their own pace and with options they select?
- How should school management plan the organization and trainings in LMSs to make teachers active users of learning technologies and to eliminate the differences in applications among faculty members?

The paper proceeds as follows. First the literature on technology adoption and usage is presented. Here the variables to be used in the structural equations model are presented as well. After the literature review the research model and hypothesis are presented. Data

analysis follows the data collection and results, and the paper ends with the conclusion and future research directions sections.

2. Literature Review

There is an extensive body of literature investigating the behavioral characteristics of technology adoption and usage. Theories on technology adoption and usage and related research contains many similar hypothesized predictors of intention to use, such as perception of innovation attributes, individual and organizational characteristics, and contextual factors. The fundamental ones are included in this section.

2.1. Technology Adoption

LMS applications are new information technologies (IT) and innovations and the intention to use these technologies is considered in technology acceptance and technology adoption literature. Previous studies examined the process and the factors influencing the adoption of IT at an organizational level, group level, or individual level. Researchers identified several factors that either help or slow down innovation adoption. The difference between an individual level of adoption and organizational adoption is that the former measures user acceptance and the actual use of innovation and the latter is used when an organization does research on a new technology that is planned to be acquired [3]. As we explore the factors affecting teachers' intentions to use LMSs, we focus on individual level of adoption and include only one organizational characteristic as a control variable, which is the voluntariness of the use of a technology in an organization in this study.

As Gopalakrishnan and Damanpour stated in their study [4] "innovation process is only successful if the innovation is accepted and integrated into the organization and individuals continue to use the innovation over a period of time". In the literature, TAM (Technology Acceptance Model), TAM extensions, UTAUT (Unified Theory of Acceptance and Use of Technology), TRA (Theory of Reasoned Action), and TPB (Theory of Planned Behavior) are some models that examine adoption at the individual level.

TAM is a behavioral model developed by [5] and is built up on TRA. TRA is based on the assumption that individuals are rational decision-makers who constantly calculate and evaluate the relevant behavior beliefs in the process of forming their attitude toward the behavior.

The technology acceptance model provides a theoretical framework to explain user acceptance of information technology products and systems. The technology acceptance model suggests that when users are presented with a new technology, a number of factors affect the decisions about how and when they will use the new technology [5].

TAM [5] consists of "perceived usefulness (PU), perceived ease of use (PEOU), attitude toward using, behavioral intention to use, and actual system use". In TAM [5], PU and PEOU are the two most important determinants of system use. TAM refers to "self-efficacy theory," the "cost-benefit paradigm," "adoption of innovations," and the "channel disposition model" as theoretical foundations. Davis found in his study that usefulness is more predictive than ease of use and one of the most significant findings is the relative strength of the usefulness and usage relationship compared to the ease of use and usage relationship [5].

TAM was found to be the most used theory in e-learning acceptance research, and a review of the literature shows that TAM-related relationships are backed most of the time. Therefore, researchers have accepted TAM as a well-established model for exploring the acceptance of e-learning technologies [6].

Increased interest in end users' reactions to information technology has increased the importance of theories that foresee and explain information technology acceptance and use. TAM is a good one with its power to explain certain relationships. However, the model need to be improved and supported with other constructs related to the context of studies for better explanatory power.

On the other hand, in technology acceptance literature the unified theory of acceptance and use of technology (UTAUT) is widely used because of its high explanatory power. UTAUT explains 70% of the variance in technology use by blending and improving the different models from prior research.

However, in e-learning acceptance and game-based learning literature there are few studies that have used UTAUT as a ground theory. Therefore, as Sumak et al. [6] stated "future research need to include studies that will evaluate this state-of-the art theory in the field of e-learning acceptance."

2.2. Unified Theory of Acceptance and Use of Technology

The unified theory of acceptance and use of technology (UTAUT) is a technology acceptance model formulated by Venkatesh et al. [7] on users' acceptance of information technology. Many studies in literature apply UTAUT to explore and explain factors affecting users' acceptance/adoption of technologies in different contexts.

UTAUT demonstrated 70% of the variance in technology use. Three straight antecedents of behavioral intention to use a technology, i.e., performance expectancy, effort expectancy, and social influence; two straight antecedents of technology use, i.e., behavioral intention and facilitating conditions; and four occasional factors, i.e., gender, age, experience, and voluntariness, that may change the influence of the antecedents on intention or behavior were named in UTAUT. In addition to four contingencies, the teaching subject (course type) was added to the model to see how it would affect the determinants or the behavior of teachers.

Performance expectancy is defined as the extent to which the user is convinced that the technology will help him or her better achieve important rewards, and performance expectancy was found to be a significant antecedent of behavioral intention, with its effect varying across gender and age such that the effect is strongest for younger men [8].

Effort expectancy is defined as the degree of ease linked with the use of the technology and it was found that the effect of effort expectancy on behavioral intention changes across gender and age such that the effect is strongest for older women when they newly start using the technology [8].

Social influence is defined as the extent to which an individual feels that people who are important to him or her believe he or she should use the new system, and it was found that the effect of social influence on behavioral intention was found to be varied depending on gender, age, experience, and voluntariness, such that it is the strongest for older women who just started using the system and where the use is mandatory [8].

Venkatesh and Zang define facilitating conditions as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system", and further report that "the effect of facilitating conditions on technology use was moderated by age and experience such that the effect was strongest for older workers in later stages of experience" [8]. Although this variable showed a significant relationship with intention, it was excluded in this study. Both users and non-users of LMS participated, therefore an evaluation of technical support was not included.

UTAUT has been popular in the literature with its high explanation power, however, many studies found some inconsistencies as well. To increase the proposed theoretical model's explanatory power, constructs from the literature that have been used to explain the intention to use LMSs are added to the constructs taken from the UTAUT model in this research.

2.3. Perceived Playfulness

Another crucial determinant of technology acceptance and use in a learning context is perceived playfulness. Past information technology (IT) research showed that user satisfaction is under strong influence of the perceived playfulness of information technology products or services [9].

Perceived playfulness can be considered to be a state of mind [10]. Based on Moon and Kim's definition, "perceived playfulness is defined as a state of mind that includes three dimensions: the extent to which the individual (1) perceives that his or her attention is focused on the interaction with the LMS (i.e., concentration); (2) is curious during the interaction (i.e., curiosity); and (3) finds the interaction intrinsically enjoyable or interesting (i.e., enjoyment)."

The playfulness concept in use of technology has been explored in previous research [11–13]. Information technologies may serve either utilitarian or hedonic purposes (or both); however, perceived playfulness or the influence of perceived usefulness depends on the essence of the system [13]. Atkinson and Kydd [14] found that playfulness is positively linked to the web for both entertainment and coursework purposes. Atkinson and Kydd [14] and Cheung et al. [15] also illustrated the significance of playfulness as the powerful intrinsic motivator underlying hedonic systems.

During the interaction and use of an LMS, there is an intensive subjective experience for the individual. A playful state can be seen as an intrinsic motivation. Extrinsic motivation refers to the desire to perform an activity because it is understood that it leads to clear and valuable outcomes [16]. Intrinsic motivation maybe be defined as "the desire to engage in an activity for no other reason than the process of performing it" [17,18]. Researchers in information systems underlined the role of extrinsic motivation in explaining user behavior in the past. In recent years researchers have gradually understood the importance of intrinsic motivation [19].

As Wang and Lin state in their study [20], "because perceived ease of use contributes to a positive interaction experience, enhanced perceptions of playfulness can be expected." In Wang and Lin's study [20], perceived playfulness was found to be the most powerful antecedent of behavioral intention, followed by perceived ease of use and perceived usefulness.

The positive support from previous studies demonstrates that perceived playfulness should be employed in technology adoption research. Gamification is also one of the rising approaches in education and playfulness is one of the top factors affecting the success of gamified applications. Perceived playfulness' effect has been studied in previous research in gamification literature; therefore, it is included to explain the intention to use LMSs in the research model.

2.4. Self-Management of Learning

Based on the McVay readiness for online learning survey, [21] administered an exploratory study to explore factors of hidden readiness for online learning and brought up a two-factor structure: "comfort with e-learning" and "self-management of learning," which is readily accountable and strongly in line with other research findings from broader flexible learning literature [22].

Self-management of learning is defined as the degree to which a person feels he or she is self-disciplined and can engage in autonomous learning [23]. Zimmerman and Pons (1986) suggested that learning achievement can be highly predicted with self-management learning capabilities as a key antecedent. Resembling words similar to the meaning of self-management of learning, the jargon consists of autonomous learning, independent learning, and self-directed learning [22,24].

As Huang [25] stated, "considering the critical impacts of self-management of learning-on-learning outcomes, although numerous researchers have focused on the relationship between self-management of learning and learning achievements, little is known about the moderating role of self-management of learning in mobile learning satisfaction and continuance intention. There is also little known about self-management of learning's effect on technology adoption."

In distance education and resource-based flexible learning literature, researchers clearly observed that self-direction or self-management of learning is required [21,26,27]. Since an LMS is an application that facilitates e-learning, a person's degree of self-management of learning is expected to have a positive effect on his or her behavioral intention to use the LMS.

Wang et al. [22] found that self-management of learning had a significant positive effect on behavioral intention to use m-learning (Mobile Learning). In addition, many studies in the past supported that self-management of learning could moderate the relationships between key mobile learning determinants, satisfaction, and continuance intention, which refers to one's intention to continually use a system or reuse a system [28–30].

As LMSs become major contributors to the learning process, self-management of the learning of individuals is expected to have a crucial role in learning and thereby in intention to use LMSs.

2.5. Perceived Learning Opportunities

Bourgonjon et al. [31] stated in their study that, "performance is the keyword in the items measuring the usefulness construct from TAM."

However, since the technology acceptance model emerged from the needs in business and commercial settings, the objectives in business are obviously different than the goals in education [32–35]. The items do not fully reflect educators' or students' motives.

Bourgonjon et al. [31] claimed that "this conceptualization of performance is too restrictive in education context and therefore, they add a new construct—perceived learning opportunities—to account for the outcomes in learning processes." Perceived learning opportunities are explained as the degree to which a person believes that using video games in the classroom can offer him or her opportunities for learning [31]. LMS applications with features that give the user better learning tools would also be expected to positively affect LMS adoption.

Bourgonjon et al. [31] also found that next to ease of use and usefulness, their study identified learning opportunities as a critical third user belief for determining students' intention to use video games in the classroom. In this research we explore the effects of how teachers' beliefs in learning opportunities affect their intention to use LMSs.

2.6. E-Learning Self-Efficacy

Self-efficacy demonstrates one's beliefs about the ability to perform different individual tasks successfully [36]. Thus, computer self-efficacy refers to the individuals' beliefs of his or her ability to finish a specific task while using his or her computer skills [37]. Roca et al. [38] proposed a decomposed TAM in the context of the e-learning system, and they demonstrated that information self-efficacy played a critical role in influencing individuals' beliefs of PEOU. Additionally, Kim et al. [39] built and tested a blended conceptual model of Internet acceptance; they hypothesized that information self-efficacy would directly affect PU and PEOU, and they found that information self-efficacy is one of the strongest predictors of PEOU.

Teachers' LMS or e-learning self-efficacy is their perception of their ability to effectively use technology in the classroom and how they accomplish tasks involved in lecturing. LMS use significantly affects teachers' actual teaching practices, so their belief on e-learning self-efficacy is important. According to Raudenbush et al. [40], "a high sense of efficacy is required if teachers are to cope successfully with the uncertainties of classroom teaching."

In the literature on teachers' adoption of technology, we see that teachers' skills in technology (e.g., technology competence and computer knowledge) are crucial for them to successfully implement classroom technology in their class [41]. First, teachers should acknowledge the enabling conditions of certain technologies, and then they can engage their students in technology-based learning activities successfully. Teachers who have lower technology competency usually do not prefer and have less certainty to integrate technology for teaching and learning activities [42]. Therefore, e-learning self-efficacy is also expected to affect effort expectancy and performance expectancy/learning outcomes next to teachers' intention to use.

2.7. Control Variables

To enhance the understanding of the generalizability of the proposed research model, the effects of the control variables on relationship paths should be analyzed. Control variables strongly affect the prediction ability of a model. In their study, Venkatesh et al. [43] analyzed eight models and found six models that had enhanced prediction ability due to additional relative control variables. Experience, voluntariness of use, gender, and age are some of the control variables that were used in previous studies. In this study, voluntariness of use, course type, gender, age, and experience were employed as control variables for multi-group analysis to test their effect on the relations hypothesized in the model.

2.8. Recent Research and M-LMS

Although we do not include this type of LMS in our research specifically, it would be impossible to omit a short discussion of the use of LMSs via mobile devices, especially with the advent of homeschool as a requirement of the COVID-19 pandemic. One study on m-LMS (mobile LMS) was conducted in Sweden and explored the reasons for the adoption of m-LMS in Sweden [44]. This study was conducted with 130 university students in Sweden. Another article [45] investigated Indonesian instructors' use of m-LMSs from the teachers' perspective. Here the researchers used similar variables as in TAM and concluded that the use of m-LMS systems is related to teachers' perceived usefulness and perceived ease of use, subjective norms and attitudes of self-efficacy, and supporting conditions. [46] also conducted research in the Palestine with more than 400 university students and evaluated the TAM model for m-LMS. Hanafi et al. [47] also investigated the use of m-LMSs for religious training in universities in Indonesia by application of the ADDIE model (analysis, design, development, implementation, and development). Researchers from Colombia [48] evaluated mobile assessment systems using 86 students who were learning English as a second language. They concluded that between the 25th min and 50th min the probability of disengagement is high. It is evident that more cross-cultural research is needed in this area as the COVID-19 pandemic conditions stay the same.

3. Development of the Research Model and Hypotheses

The research model derives its theoretical foundations from prior research in technology acceptance models. A group of studies have proposed that extending TAM with external variables may provide a more comprehensive picture of the IS/IT (Information Sytems and Information Technology) acceptance process [32,39]. Several types of external variables can be central to users' intention to use LMSs in an education context. Therefore, these external factors gathered from previous research were included in the research model, aiming to increase its explanatory power.

A quantitative study was designed in order to test the research model depicted in Figure 1. The following hypotheses were derived, relating to the factors affecting adoption of LMSs.

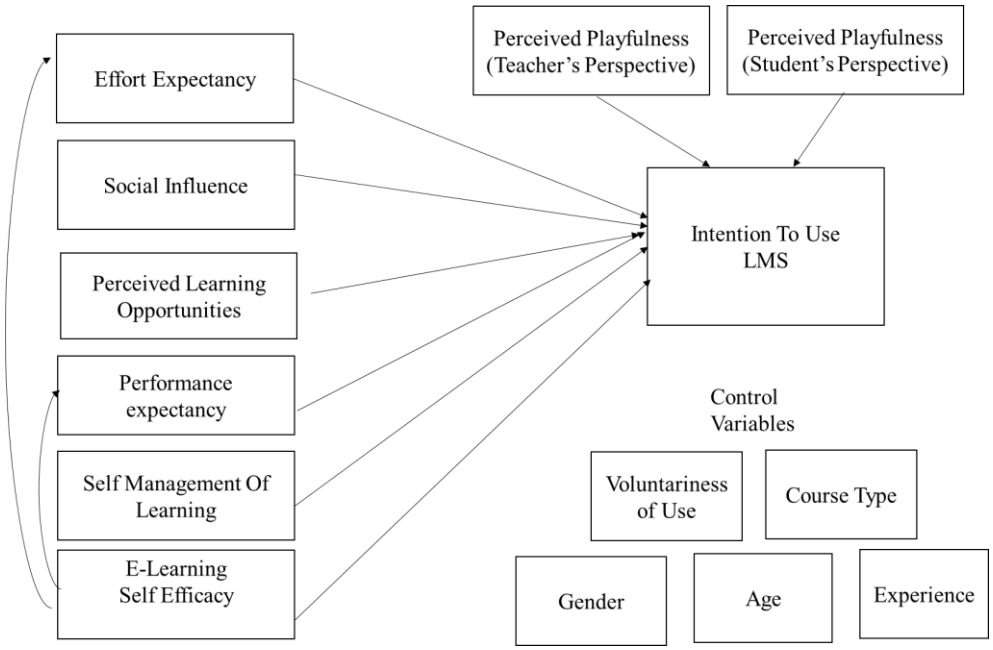

Figure 1. Preliminary research model.

Hypothesis 1 (H1). *The effort expectancy of using LMSs has a positive effect on the behavior of the intention to use an LMS.*

Hypothesis 2 (H2). *The social influence of using LMSs has a positive effect on the behavior of the intention to use an LMS.*

Hypothesis 3 (H3). *The perceived playfulness (teachers' perspective) of an LMS has a positive effect on the behavior of the intention to use an LMS.*

Hypothesis 4 (H4). *The perceived playfulness (students' perspective) of an LMS has a positive effect on the behavior of the intention to use an LMS.*

Hypothesis 5 (H5). *The perceived learning opportunities of an LMS has a positive effect on the behavior of the intention to use an LMS.*

Hypothesis 6 (H6). *The performance expectancy of an LMS has a positive effect on the behavior of the intention to use an LMS.*

The following hypotheses were derived relating to the individual characteristics of the users or potential users of LMSs.

Hypothesis 7 (H7). *The e-learning self-efficacy of a teacher has a positive effect on the behavior of the intention to use an LMS.*

Hypothesis 8 (H8). *The e-learning self-efficacy of a teacher has a positive effect on the effort expectancy of an LMS.*

Hypothesis 9 (H9). *The e-learning self-efficacy of a teacher has a positive effect on the performance expectancy of an LMS.*

Hypothesis 10 (H10). *The self-management of the learning of a student has a positive effect on the behavior of the intention to use an LMS.*

Hypothesis 11 (H11). *Control variables have impact on all relationships in the research model.*

All relationships and constructs that are included in the model are depicted in Figure 1.

4. Research Methodology

The developed theoretical model was tested and validated through a field study on large-scale user surveys focusing on LMSs. The primary method used for data analysis was structural equation modelling (SEM). The hypotheses were tested. The constructs in the measurement model were validated using confirmatory factor analysis (CFA). The relationships in the structural model were tested through path analysis. Multi-group structural equation modeling analyses were conducted to see the effects of the control variables in the measurement model.

4.1. Measurement Instrument

A research survey was developed to test all hypotheses formulated from the relationships proposed in the research model. A scale was prepared to measure the factors that influence teachers' intention to use learning management systems.

To ensure the content validity of the scales, the items selected must represent the concept about which generalizations are to be made [22]. Scale items that are used to measure performance expectancy, effort expectancy, social influence, and behavioral intention were adapted from [7]. The items for the perceived playfulness construct were adapted from Moon and Kim [10]. Items for the perceived learning opportunities construct were adapted from Bourgonjon et al. [31]. Items for the self-management of learning construct were adapted from Smith et al. [21]. Finally, one item for the self-efficacy construct was adapted from Hsu & Chiu [9], three items were adapted from Roca et al. [38], one item was adapted from Compeau & Higgins [37], and last two items were adapted from Ong et al. [49]. All the items were modified to make them relevant in the use of learning management systems context. Respondents were asked to state their agreement level on a 7-point Likert scale ranging from completely agree: 1 to completely disagree: 7 for the statements (items) of all construct items. In Appendix A the full list of survey items is listed.

4.2. Data Collection Method and Sample

The non-probability purposive sampling (also known as judgmental) method was followed in this research. The data collection started in December 2017 and lasted until May 2018. The predefined group was primary and secondary school teachers who worked in Turkey. Any male or female primary and secondary school teachers aged between 20 and 60 years old could participate in this research. Participation in this research was based on voluntariness. A total of 452 answers were collected. Demographic information that describes the characteristic of the sample is shown in Table 1.

Aside from demographic information, the teachers were asked about their voluntariness to use LMSs. A total of 67% of the teachers stated that they used LMSs voluntarily in their institutes. Lastly, we asked teachers about their teaching subjects. A total of 21% of the sample were primary school class teachers, 16% of the instructors in the sample taught science, and 15% percent of the teachers taught foreign languages. The rest of the sample was distributed among other subjects such as mathematics, Turkish literature, social sciences, physical education, and counseling. The distribution of the teachers according to the different subjects is provided in the demographic characteristics in Table 1.

Table 1. Demographic characteristics of the participating primary and secondary school teachers.

Variables	Number (N)	Percent (%)
Age		
20–30	105	23.28
31–40	176	39.02
41–50	107	23.73
51–60	54	11.97
Over 60	9	2
Gender		
Female	308	69.84
Male	133	30.16
Experience		
0–5	86	19.11
6–10	84	18.67
11–20	155	34.44
21–30	85	18.89
31–40	33	7.33
Over 40	7	1.56
Learning Management System Use Status		
Experienced	294	65.04
Not Experienced	158	34.96
Voluntariness		
Voluntary	291	66.9
Compulsory	144	33.1
Course Type		
Turkish Literature	37	8.19
Foreign Languages	68	15.04
Social Sciences	37	8.19
Counseling	19	4.2
Science	73	16.15
Mathematics	49	10.84
Religion and Ethics	9	1.99
Physical Education	10	2.21
Art	10	2.21
Music	8	1.77
Primary Class Teacher	96	21.24
Others	36	7.96

5. Data Analysis and Results

5.1. Assessment of Measurement Model

A confirmatory factor analysis (CFA) using AMOS 19 was conducted for each construct to test the measurement model. Six common model-fit measures were used to assess the model's overall goodness of fit: the ratio of chi square to degrees of freedom (df), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normalized fit index (NFI), comparative fit index (CFI), Tucker–Lewis index (TLI), and root mean square error of approximation (RMSEA).

Most CFA results showed strong goodness-of-fit measures for all constructs, as shown in Table 2. It was observed that a few fit indices of four constructs fell out of the threshold levels due to several reasons. The effort expectancy construct's RMSEA value was over the commonly accepted threshold level. The social influence construct's CMIN/df value (minimum discrepancy divided by degrees of freedom) was slightly over the threshold value. The perceived playfulness (students' perspective) construct's CMIN/df and RMSEA values were slightly over the threshold values that are used commonly in the literature.

This might be due to the sample size, as our sample was 452, which is very close to 500. Hair et al. stated in their study (2010) that the "Chi squared value tends to get inflated and may be misleading for sample sizes over 500." Similar to perceived playfulness (students' perspective), the CMIN/df and RMSEA values were slightly over the threshold values. As explained earlier, this might have been due to the sample size. Since all other remaining goodness-of-fit measures were at commonly accepted threshold values for these four constructs, it was found to be adequate for the overall model fit.

Table 2. Fit indices for constructs in the measurement model.

	CMIN/df	GFI	CFI	TLI	NFI	RMSEA
Threshold (Hair et al., 2010)	<3	>0.95	>0.90	>0.90	>0.90	<0.05
Effort expectancy	2.603	0.997	0.999	0.995	0.999	0.6
Social influence	0.347	1	1	1.003	1	0
Perceived playfulness (teacher's perspective)	0.292	1	1	1.003	1	0
Perceived playfulness (student's perspective)	3.023	0.997	0.999	0.992	0.998	0.067
Learning Opportunities	3.88	0.972	0.991	0.984	0.987	0.08
Performance Expectancy	2.126	0.997	0.999	0.997	0.998	0.05
Self-Management of Learning	1.826	0.998	0.999	0.997	0.999	0.043
E-Learning Self Efficacy	0.626	0.998	1	0.999	0.999	0
Intention to Use	0.749	0.999	1	1	1	0

5.2. Structural Model and Hypotheses Testing

The preliminary research model was first put into a structural equation modeling analysis to see the model fit. However, it was observed that model fit values were not at acceptable levels, as presented in Table 3.

Table 3. Measurement of model fit indices—preliminary research model.

Measure	Value	Threshold [50]
CMIN/df	110.707	<3
GFI	0.465	>0.95
CFI	0.4	>0.90
TLI	0.099	>0.90
NFI	0.399	>0.90
RMSEA	0.496	<0.05

The model needed re-specification. The re-specified structural model was constructed with six exogenous factors with 28 observed variables and three endogenous factors with 10 observed variables. Intention to use, effort expectancy, and performance expectancy were the endogenous factors, whereas social influence, perceived playfulness (teachers' perspective), perceived playfulness (students' perspective), perceived learning opportunities, e-learning self-efficacy, and self-management of learning were the exogenous factors. Age, gender, experience, course type, and voluntariness of use were the control variables in the model. The re-specified model's goodness-of-fit values were all in an acceptable range (CMIN/df: 3.371, GFI: 0.988, CFI: 0.996, TLI: 0.981, NFI: 0.995, and RMSEA: 0.053). The structural model estimates are presented in Table 4 and Figure 2.

Table 4. Factors affecting LMS adoption: final structural model estimates.

	Relationship	Unstandardized Beta	Standard Beta	Standard Error	T Value	*p* Value	Result
H13	Effort Expectancy < – Perceived Playfulness (Teacher's perspective)	0.331	0.319	0.042	7.798	***	Supported
H9	Performan ce Expectancy< – E -Learning Self Efficacy	0.211	0.186	0.038	5.586	***	Supported
H15	Performan ce Expectancy< – Perceived Learning Opportunit ies	0.574	0.525	0.044	44,178	***	Supported
H12	Effort Expectancy< – Social Influence	0.311	0.309	0.036	8.742	***	Supported
H14	Performan ce Expectancy Perceived Playfulness < – (Teacher's perspective)	0.281	0.264	0.038	18,080	***	Supported
H8	Effort Expectancy< – E -Learning Self Efficacy	0.364	0.329	0.043	16,650	***	Supported
H2	Intention To Use< – Social Influence Perceived	0.015	0.014	0.043	0.355	0.723	Rejected
H3	Intention To Use< – Playfulness (Teacher's perspective)	0.127	0.114	0.064	1.998	0.046	Supported
H4	Intention To Use< – Perceived Playfulness (Student's Perspective)	0.052	0.047	0.062	0.827	0.408	Rejected
H5	Intention To Use< – Perceived Learning Opportunit ies Self-	0.171	0.15	0.085	2.005	0.045	Supported
H10	Intention To Use< – Manageme nt of Learning	−0.028	−0.025	0.035	−0.8	0.424	Rejected
H7	Intention To Use< – E -Learning Self Efficacy	0.552	0.466	0.058	9.449	***	Supported
H6	Intention To Use < – Performance Expectancy	0.068	0.066	0.066	1.033	0.302	Rejected
H1	Intention to use < –Effort Expectancy	0.087	0.081	0.052	1.683	0.092	Rejected

*** *p*-value < 0.001.

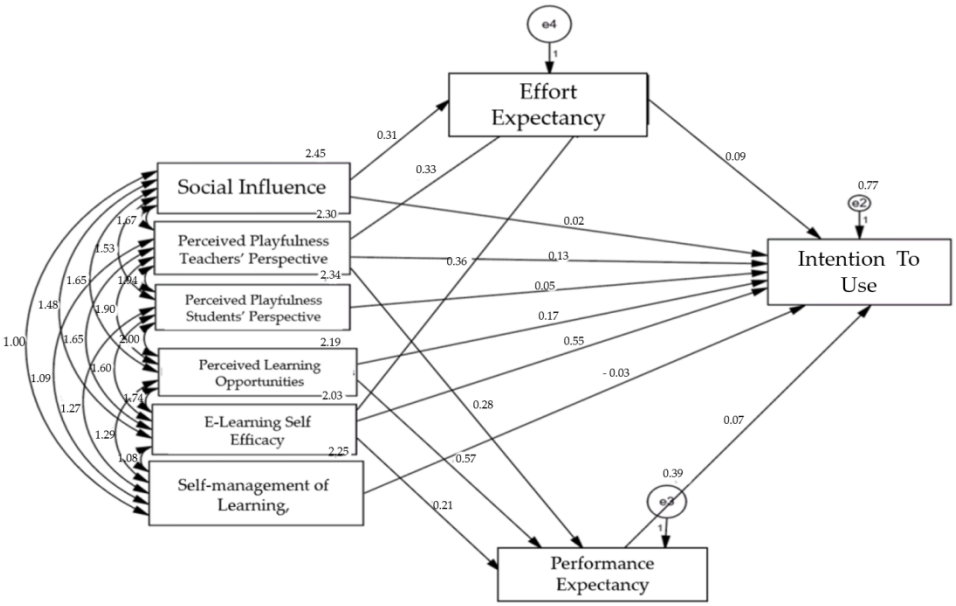

Figure 2. Final structural model with standardized estimates.

With the re-specification, in addition to the 11 hypotheses proposed in the preliminary research model, four new hypotheses were proposed. Therefore, in addition to testing the effect of the control variables, 14 relations were tested using structural equation modeling analysis. The newly proposed hypotheses were as follows.

Hypothesis 12 (H12). *Social influence has a positive effect on effort expectancy.*

Hypothesis 13 (H13). *Perceived playfulness (teachers' perspective) has a positive effect on effort expectancy.*

Hypothesis 14 (H14). *Perceived playfulness (teachers' perspective) has a positive effect on performance expectancy.*

Hypothesis 15 (H15). *Perceived learning opportunities have a positive effect on performance expectancy.*

Path analysis results showed that nine out of the 14 proposed relationships were supported in the structural model. Five out of the 10 proposed relationships from the preliminary research model were supported and four out of the four newly proposed relationships were supported in the structural model.

The results confirmed that perceived learning opportunities of LMSs had a positive effect on usage intention (H5), whereas the positive effect of performance expectancy (H6) of LMSs on usage intentions, as proposed in the preliminary research model, was rejected. This result confirmed [31] claim that goals in education and business are different and that performance expectancy constructs and their items can be too restrictive in an education context. Therefore, in line with their proposition, this study supported the positive effect of learning opportunities on usage intention. The learning opportunities construct, which is explained as "the degree to which a person believes that using LMS in the classroom can offer him or her opportunities for learning" [31], reflected educators' motives better than the performance expectancy construct.

In addition, the results confirmed that perceived learning opportunities have a positive direct impact on performance expectancy (H9), with a standard estimate of 0.525 at a significant level.

The results also indicated that although perceived playfulness (teachers' perspective) has a direct effect on usage intention (H3), perceived playfulness (students' perspective) has no direct effect on usage intention (H4). The standard estimate for the relationship in H3 was 0.114 and the relationship was found to be statistically significant (p-value < 0.050). In H4 the standard estimate for the relationship was 0.047 and the relationship was found to be statistically insignificant (p-value = 0.408 > 0.050). The perceived playfulness construct was defined as a state of mind that includes three dimensions in Moon and Kim's study (2001). These three dimensions are users' attention being focused on an LMS, user's level of curiosity during interaction with an LMS, and users' enjoyment while using an LMS. The survey was conducted among teachers. The data collected from the teachers showed that teachers' behavioral intention to use was positively affected by their belief in LMSs that have features that attract their attention and interest and that they enjoy using. On the other hand, teachers' belief that an LMS would attract students' attention and curiosity did not have a direct positive effect on their behavioral intention to use an LMS.

The hypotheses that indicated that perceived playfulness (teachers' perspective) has a positive effect on performance expectancy (H14) and effort expectancy (H13) were also confirmed. The standard estimate of the relationship for H14 was 0.264 and the standard estimate for H13 was 0.319. Both relationships were found to be significant. In previous research, several studies tested the empirical relevance of perceived playfulness as an integrative variable of the TAM model, and as Padilla-Melendez et al. found in their study [51], perceived playfulness has a significant positive effect on PU and PEOU.

As was proposed in H1, effort expectancy's effect on usage intentions was not confirmed, since the *p*-value (0.092) was greater than the cut-off level (0.050). It was also found that social influence did not have a positive effect on teachers' intention to use an LMS (H2) (*p*-value = 0.723 > 0.050). On the other side, social influence was found to have a positive impact on effort expectancy (H12) at a significant level.

Social influence was found to be an important antecedent of effort expectancy in previous studies in the literature as well [52]. E-learning self-efficacy had a significant effect on usage intention (H7), with a standardized estimate of 0.466; performance expectancy (H8), with a standardized estimate of 0.186; and effort expectancy (H9), with a standardized estimate of 0.329. As Bandura explained [36] self-efficacy is the demonstration of users' beliefs about the ability to perform different individual tasks successfully. This study confirmed that teachers' belief in their ability to use LMSs successfully has a positive impact on their intention to use LMSs, on their belief in how much effort they need to give to be able to use an LMS, and also on their belief about how useful an LMS would be for their work. Their belief in their ability to use the technology not only affected their intention to use, but also affect their belief in features of the technology.

The results indicated that self-management of learning did not have a direct impact on teachers' usage intention, with *p*-value of 0.424, which was higher than the threshold value. This observation was believed to be the result of the approach to education in most institutions in Turkey. Teachers' belief in students' ability to manage their own studies should be examined more. Since parents', teachers', and institutions' focus is national exam scores, most students do not have the freedom or responsibility to manage their own studies in the Turkish education system.

5.3. Multi-Group Srtuctural Equation Modeling

Multi-group analyses were conducted following the testing of the final structural model. First regression analyses were conducted for the structural model for women and men. There were 307 women and 129 men in the sample. The goodness-of-fit values of the model for both women and men were at acceptable levels. In one path, differences were found. The path between performance expectancy and intention to use was insignificant for men, whereas it was significant for women, with an estimate of 0.037 (*p*-value = 0.037 < 0.050).

Secondly, regression analyses were conducted on the structural model for voluntariness of use. There were differences in two paths. Perceived learning opportunities were found to have a significant positive impact on intention to use for the group that indicated that using LMSs was compulsory in their institution, whereas this path was found to be insignificant for the group that indicated LMS use was voluntary in their institution. Effort expectancy was found to have a positive impact on the intention to use construct at a significant level for the group that indicated that LMS use was voluntary, whereas the path was found to be insignificant for the group that indicated LMS use was compulsory.

Standard regression weights for LMS users and non-LMS users were also observed. The results showed differences in two paths. Perceived playfulness (teachers' perspective) was found to have a significant impact on the usage intentions of teachers who had used an LMS before, with an estimate of 0.171 and *p*-value of 0.015, which was less than the threshold value (0.050). For teachers who had not used an LMS before, perceived playfulness (teachers' perspective) did not have a significant impact on usage intention, as shown in Appendix B. Perceived learning opportunities had a positive impact on usage intention at a significant level for teachers who had not used an LMS before, whereas there was no significant impact in this path for teachers who had used an LMS before.

Regression analyses were conducted for different experience groups. Differences were observed in eight paths in different experience groups. The perceived playfulness (teachers' perspective) construct was found to have no significant impact on effort expectancy for teachers with 0–5 years of experience. On the other hand, in all other experience groups there was a significant relationship. The social influence construct was found to have a significant positive impact on the effort expectancy construct for all experience groups

except for the group with 31 years of experience or more. Perceived playfulness (teachers' perspective) was found to have a significant positive impact on the performance expectancy construct for all experience groups except for the group with 31 years of experience or more. The path from e-learning self-efficacy construct to the effort expectancy construct was found to be significant for all experience groups except for the group with 21–30 years of experience. Perceived playfulness (teachers' perspective) was found to have a significant impact on usage intentions of teachers with 21–30 years of experience only with a standard estimate of 0.345 and *p*-value of 0.006, which was below threshold; for the rest of the groups the relation was found to be insignificant. Perceived playfulness (students' perspective) was found to have a significant positive impact on intention to use for teachers with 0–5 years of experience, with a standard estimate of 0.316; the relationship was insignificant for the rest of the groups. The relationship between performance expectancy and intention to use was found to be significant only in the group with 11–20 years of experience.

Regression analyses were conducted on the structural model for the age of the teachers. Differences were observed in six different paths for different age groups. The perceived playfulness (teachers' perspective) construct was found to have no significant impact on effort expectancy for teachers aged between 20 and 30 years old; on the other hand, in all other age groups there was a significant relationship. This was found to be in line with the experience variable. For teachers with 0–5 years of experience this relation was found to be insignificant. The perceived playfulness (teachers' perspective) construct was found to have no significant impact on performance expectancy for teachers aged 51 years and above; there was a significant relationship in all other age groups. The e-learning self-efficacy construct's impact on effort expectancy was found to be insignificant for teachers aged 51 years and above; there was a significant positive relationship in all other age groups. The social influence construct was found to have a significant negative impact on the intention to use construct for teachers aged 51 years and above, with a standard estimate of -0.255 and p-value = $0.025 < 0.05$, whereas this relationship was insignificant for all other age groups. The perceived playfulness (students' perspective) construct was found to have a significant positive impact on intention to use for teachers who were 20 to 30 years old, with a standard estimate of 0.249 and p-value = $0.01 < 0.05$, as listed in Appendix B. This relationship was insignificant for all other age groups. This finding was in line with the findings in the experience groups. The relationship was found to be significant for teachers who had 0 to 5 years of experience. This shows us that younger teachers put more emphasis on LMSs' playfulness features for students. Game-based learning is a fairly new concept in the Turkish education system. In order to increase usage of LMSs among teachers, institutions should focus on trainings that show opportunities provided by game-based learning tools and playfulness elements' positive effect on learning outcomes. The effort expectancy construct was found to have a positive significant impact on the intention to use construct for teachers aged between 31 and 40 years, whereas the relationship was found to be insignificant for all other age groups.

Finally, regression analyses were conducted on the structural model for the course type of the teachers. Differences were observed in seven different paths. The perceived playfulness (teachers' perspective) construct was found to have no significant impact on the effort expectancy construct for foreign language teachers; on the other hand, for teachers of all other course types there was a significant relationship. The e-learning self-efficacy construct was found to have no significant impact on the performance expectancy construct for primary school class teachers or for science and mathematics teachers, whereas the relationship was significant for other teacher groups. Social influence was found to have a positive significant impact on effort expectancy for all course type groups, excluding primary school teachers. The perceived playfulness (teachers' perspective) construct was found to have no significant impact on intention to use for all course type groups, excluding music, physical education, arts, and "others" teachers. The perceived learning opportunities construct was found to have no significant impact on intention to use for all course type groups, excluding social sciences, Turkish literature, counseling, and religion

and ethics teachers. The self-management of learning construct was found to have no significant impact on intention to use for all course type groups, excluding music, physical education, arts, and "others" teachers. The performance expectancy construct was found to have no significant impact on intention to use for all course type groups, excluding social sciences, Turkish literature, counseling, and religion and ethics teachers.

6. Conclusions

Learning management systems have become a major strategic component of education institutes. Efficient use of these technological platforms allows effective control of administration automation; communication with users, teachers, students, and parents; and content management. Many education institutes include these technological platforms as one of their value propositions in their marketing communications. Although LMS development companies claim that these technologies have a positive effect on education management and learning environment, factors affecting teachers' beliefs on the use of these innovations have not been fully defined, analyzed, or explained in previous literature. There is some research based on university students and faculty members, however, there is very little research explaining primary and secondary school teachers' beliefs on LMS usage. This research attempted to fill this gap. This study can be a foundation for future research regarding learning management system adoption and use by teachers in primary and secondary schools.

In the study of the factors affecting LMS usage by primary and secondary school teachers, e-learning self-efficacy was found to be the strongest positive determinant of usage intention. Powerful positive relationships between e-learning self-efficacy and performance expectancy and e-learning self-efficacy and effort expectancy were proven. Effort expectancy's effect on usage intention was found to be insignificant. Perceived learning opportunities were found to be a strong indicator of usage intention. Although the perceived playfulness (teachers' perspective) construct's positive impact on usage intention was proven, the perceived playfulness (students' perspective) construct's impact was rejected. Perceived playfulness' (teachers' perspective) effect on performance expectancy and effort expectancy were added as two new relationships to the model after CFA and both were found to be positive and significant. Although social influence's effect on usage intention was rejected, its effect on effort expectancy was supported. Perceived learning opportunities were also found to have positive impact on performance expectancy. The self-management of learning construct's positive direct impact on intention to use was rejected.

Multi-group analyses indicated that performance expectancy had a positive direct effect on usage intention for female teachers. The relation was insignificant for male teachers. This shows that female teachers with high performance expectancy are more likely to adopt an LMS than female teachers with lower performance expectancy. In experience groups, the relation between performance expectancy and intention to use was found to be significant for teachers with 11 to 20 years of experience. Lastly, in the social science, literature, counseling, and ethics teacher group, the relation was found to be significant. Therefore, it is believed that teachers of these two groups who have higher performance expectancy tend to have higher intention to use an LMS. Perceived learning opportunities' effect on usage intention was found to be significant for the group of teachers who indicated that LMS use was not voluntary in their institutions. On the contrary, performance expectancy's effect on usage intention was found to be significant for teachers who indicated that LMS use was voluntary in their institutions. In terms of LMS use, perceived playfulness (teachers' perspective) was found to have a significant impact on usage intention for those who had used an LMS before. Perceived learning opportunities had a significant positive impact on usage intention for those who had not used an LMS before. This shows that if LMS non-users expect LMSs to create opportunities to make improvements in learning outcomes, they are more likely to adopt an LMS. Differences in relationships were observed in the experience groups. Perceived playfulness' (students'

perspective) effect on usage intention was found to be significant for teachers with 0 to 5 years of experience only; the relation was found to be significant for teachers who were 20 to 30 years old, too. The relation was rejected in the model. Social influence was found to have a significant impact on usage intention only for teachers who were 51 years old and over, but the relation was negative.

This study has important theoretical implications concerning the adoption and use of LMSs in an education context. One of the contributions of this study is an examination of technology acceptance and use in an end-user context. The sample used for factors affecting LMS-use research is also an important data contribution to the theory, since there are very few studies exploring the beliefs of primary and secondary schools teachers.

Our findings have important implications for practitioners, especially for those specializing in educational technology development, education management, and school management. Developing technologies requires deep understanding of technological features, the individual characteristics of target users, and the organizational characteristics of institutions. In addition to the factors in a business context, LMS developers should take into account factors that are specific to an education context.

Perceived learning opportunities are a very effective innovation attribute. Therefore, developers should work with educators to understand effective learning processes so they can include features supporting these processes in LMS design. In addition, developers should understand playfulness elements for both students and teachers very well before developing technologies. E-learning self-efficacy is one the strongest indicators of usage intention. Both innovation developers and education managers should take into consideration users' ability to use technologies and organize effective on-job trainings and provide support to users to increase usage.

Innovation attributes and individualistic characteristics that affect users' intention to use should be considered separately for different customer segments. Teachers' beliefs about these factors change according their age, experience, or teaching subject. School managers should organize mixed groups of teachers from different age and experience groups to work on these perceptions of LMSs to increase LMS usage. The perceptions of teachers from different age groups and experience groups are different. Learning processes and teaching techniques in different course types should be taken into account and features relevant to the course type should be integrated into different subjects' modules in LMS design.

Lastly, voluntariness of use affects the perceptions of users. Teacher trainings should aim to convince teachers about the positive impact of LMSs on tasks that should be completed and on the learning environment. Demonstrating how much effort they need to give to use these technologies and what they get in return may reduce teachers' concerns about their perception of effort expectancy. A summary of the main findings is presented in Table 5.

Table 5. Effects on intention to use LMS systems.

Measure	Sign of the Relationship
Self-efficacy	Strongest positive
Effort expectancy	Insignificant
Perceived learning opportunities	Strong positive
Perceived playfulness (teacher)	Positive
Perceived playfulness (student)	Insignificant
Social influence	Insignificant
Self-management	Insignificant

7. Limitations and Future Research

The data were collected mostly from schools in İstanbul. Future studies should focus on collecting data from all around Turkey. To better observe the playfulness constructs' effect on usage, an experimental study can be designed. This way the playfulness level of

technology can be controlled and its effect can be measured. The use intention of students would be expected to be an indicator of LMS adoption by teachers. An experimental study can be designed to observe students' usage of LMSs as well.

Future research may also tackle how learning at home couples with the different types of learning management systems. The pandemic has changed many aspects of social and economic life [53] and this includes the delivery of education. Completely online learning and hybrid systems have replaced traditional modes of delivery. How LMSs interact with the new type of learning-at-home systems is definitely worth investigating. In addition, as discussed in Section 2.8, m-LMS is an area worth further inquiry.

"Big Data" is also a fairly new concept covering new techniques to extract knowledge from massive data sets [54]. LMS systems may also benefit from the user data collected from students' and teachers' interactions with the computer software.

LMS systems are not only used in secondary education but also in higher education [55]. Further research on the attitudes towards the adoption of LMS systems in higher education may be needed.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy of the respondents and schools.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Survey items and sources.

No.	Questionnaire Items By Construct	Turkish Version	Source
1	What is your gender?	*Cinsiyetiniz nedir?*	
2	What is your age?	*Kaç yaşındasınız?*	
3	Please state your years of experience in teaching.	*Kaç yıldır öğretmenlik yapıyorsunuz?*	
4	What is your subject?	*Dalınız nedir?*	
5	Have you used a learning management system before?	*Daha Önce Öğrenme Yönetim Sistemi kullandınız mı*	
6	Using an LMS is voluntary in my institution.	*Kurumumda Öğrenme Yönetim Sistemlerini gönüllü olarak kullanıyorum (zorunlu değil)*	
	Effort Expectancy		
7.1	My interaction with an LMS would be clear and understandable.	*Öğrenme yönetim sistemleri ile etkileşimim açık ve anlaşılabilir olur*	[7]
7.2	It would be easy for me to become skillful at using an LMS.	*Öğrenme Yönetim Sistemlerini kullanmada becerikli olmak benim için kolay olur*	[7]
7.3	I would find an LMS easy to use.	*Öğrenme Yönetim Sistemlerini kullanmayı kolay bulurum*	[7]
7.4	Learning to operate an LMS is easy for me.	*Öğrenme yönetim sistemlerini kullanmayı öğrenmek benim için kolay olur*	[7]

Table A1. *Cont.*

No.	Questionnaire Items By Construct	Turkish Version	Source
	Social Influence		
7.5	People who influence my behavior will think that I should use an LMS.	*Davranışımı etkileyen insanlar (çalışma arkadaşlarım, yöneticilerim) Öğrenme Yönetim Sistemlerini kullanmam gerektiğini düşünüyor*	[7]
7.6	People who are important to me will think that I should use an LMS.	*Görüşlerini önemsediğim insanlar Öğrenme Yönetim Sistemlerini kullanmam gerektiğini düşünüyor*	[7]
7.7	The seniors in my organization have been helpful in the use of LMSs.	*Çalıştığım kuruluştaki üst düzey görevliler (yöneticilerim) Öğrenme Yönetim Sistemlerini kullanmamda yardımcı olurlar*	[7]
7.8	In general, my organization has supported the use of an LMS.	*Genel olarak, çalıştığım kuruluş Öğrenme Yönetim Sistemlerini kullanımını destekliyor*	[7]
	Perceived playfulness from teachers' perspective		
7.9	When using an LMS, I will not realize time has passed.	*Öğrenme Yönetim Sistemlerini kullanırken zamanın nasıl geçtiğini anlamam*	[10]
7.1	When using an LMS, I will forget the work I must do.	*Öğrenme yönetim sistemlerini kullanırken yapmam gereken diğer işleri unutuyorum*	[10]
7.11	Using an LMS will give enjoyment to me in my work.	*Öğrenme Yönetim Sistemlerini kullanarak işimi yapmak bana keyif verir*	[10]
7.12	Using an LMS will stimulate my curiosity.	*Öğrenme Yönetim Sistemlerini kullanmak merak duygumu tetikler*	[10]
7.12	Using an LMS will lead me to explore.	*Öğrenme Yönetim Sistemlerini kullanmak beni araştırmaya yöneltir*	[10]
	Perceived Playfulness from Students' Perspective		
7.14	When using an LMS, students will not realize time has passed.	*Öğrenciler Öğrenme Yönetim Sistemlerini kullanırken zamanın nasıl geçtiğini anlamaz*	[10]
7.15	When using an LMS, students will forget the work they must do.	*Öğrenciler Öğrenme Yönetim Sistemlerini kullanırken yapmaları gereken diğer görevlerini unutur*	[10]
7.16	Using an LMS will provide enjoyment to students in their learning.	*Öğrenme Yönetim Sistemlerini kullanarak öğrenmek öğrencilere keyif verir*	[10]
7.17	Using an LMS will stimulate students' curiosity.	*Öğrenme Yönetim Sistemleri öğrencilerin merak duygusunu tetikler*	[10]
7.18	Using an LMS will lead to students' exploration.	*Öğrenme Yönetim Sistemleri öğrencileri araştırmaya yönlendirir*	[10]
	Perceived Learning Opportunities		
7.19	LMSs offer opportunities to experiment with knowledge.	*Öğrenme Yönetim Sistemleri bildiklerinizi deneme/ test etme imkanı verir*	[31]
7.2	LMSs offer opportunities to take control of the learning process.	*Öğrenme Yönetim Sistemleri öğrenme süreci üzerinde kontrol sahibi olma imkanı verir*	[31]
7.21	LMSs offer opportunities to experience things you learn about.	*Öğrenme Yönetim Sistemleri öğrendiğiniz şeyleri deneyimleme imkanları sunar*	[31]
7.22	LMSs offer opportunities to stimulate transfer between various subjects.	*Öğrenme Yönetim Sistemleri farklı konular arasında aktarım yapmayı teşvik eder*	[31]
7.23	LMSs offer opportunities to interact with other students.	*Öğrenme Yönetim Sistemleri diğer öğrencilerle etkileşim kurma imkanı sunar*	[31]

Table A1. *Cont.*

No.	Questionnaire Items By Construct	Turkish Version	Source
7.24	LMSs offer opportunities to think critically.	*Öğrenme Yönetim Sistemleri eleştirel düşünme olanakları verir*	[31]
7.25	LMSs offer opportunities to motivate students.	*Öğrenme Yönetim Sistemleri öğrencilerin motivasyonlarını artırma fırsatları sunar*	[31]
	Performance Expectancy		
7.26	I would find an LMS useful in my job.	*Öğrenme Yönetim Sistemlerini işimde faydalı bulurum*	[7]
7.27	Using an LMS enables me to accomplish tasks more quickly.	*Öğrenme Yönetim Sistemlerini kullanarak görevlerimi daha hızlı tamamlarım*	[7]
7.28	Using an LMS increases my productivity.	*Öğrenme Yönetim Sistemlerini kullanmak verimliliğimi artırır*	[7]
7.29	If I use an LMS, I will increase my chances of getting a raise.	*Öğrenme Yönetim Sistemlerini kullanırsam maaşıma zam alma (terfi) şansımı artırırım*	[7]
	Self-Management of Learning		
7.3	When it comes to learning and studying, I am a self-directed person.	*Öğrenciler öğrenme konusunda kendi kendilerini yönetirler*	[21]
7.31	In my studies, I am self-disciplined and find it easy to set aside reading and homework time.	*Öğrencilerin öz disiplinleri var, okuma ve ödev zamanlarını kolaylıkla kendileri ayarlar*	[21]
7.32	I am able to manage my study time effectively and easily complete assignments on time.	*Öğrenciler çalışma zamanlarını verimli kullanır ve ödevlerini (görevlerini) zamanında kolaylıkla bitirir*	[21]
7.33	In my studies, I set goals and have a high degree of initiative.	*Öğrenciler çalışmalarında hedeflerini belirler ve çalışma sorumluluğunu alırlar*	[21]
	LMS Self-Efficacy (items will be eliminated and returned to context-related ones)		
7.34	I feel confident about finding information and downloading files in the LMS.	*Öğrenme Yönetim Sistemini kullanarak aradığım bilgiyi bulma ve dosya yüklemeyi rahatlıkla yapabilirim*	[9]
7.35	I feel confident about attaching files to emails in the e-learning system.	*Öğrenme Yönetim Sistemini kullanarak e-postalarıma rahatlıkla dosya eki ekleyebilirim*	[38]
7.36	I feel confident about exchanging messages with other users in discussion forums in the e-learning system.	*Öğrenme Yönetim Sistemlerindeki tartışma forumlarında diğer kullanıcılar ile rahatlıkla mesajlaşırım*	[38]
7.37	I feel confident about posting messages on a bulletin board in the e-learning system.	*Öğrenme Yönetim Sistemlerindeki duyuru panolarına rahatlıkla mesaj yollayabilirim*	[38]
7.38	I could complete my learning activities using the e-learning system if I had never used a system like it before.	*Daha önce hiç böyle bir sistem kullanmamış da olsam, Öğrenme Yönetim Sistemlerini kullanarak görevlerimi tamamlayabilirim*	[37]
7.39	I could complete my learning activities using the e-learning system if I had only the system manuals for reference.	*Referans olarak sadece sistem el kitabım olsa dahi Öğrenme Yönetim Sistemini kullanarak görevlerimi tamamlayabilirim*	[49]
7.4	I could complete my learning activities using the e-learning system if I had seen someone else using it before trying it myself.	*Daha önce başkasının kullanırken gördüğüm bir Öğrenme Yönetim Sistemini kullanarak görevlerimi tamamlayabilirim*	[49]

Table A1. *Cont.*

No.	Questionnaire Items By Construct	Turkish Version	Source
	Behavioral Intention to Use an LMS		
7.41	I intend to use an LMS in the future.	*Gelecekte Öğrenme Yönetim Sistemlerini kullanmaya niyetliyim*	[7]
7.42	I predict I would use an LMS in the future.	*Gelecekte Öğrenme Yönetim Sistemlerini kullanacağımı umuyorum*	[7]
7.43	I plan to use an LMS in the future.	*Gelecekte Öğrenme Yönetim Sistemlerini kullanmayı planlıyorum*	[7]

Appendix B

Table A2. Factors affecting LMS adoption: regression analysis results for gender.

Standardized Regression Weights: Gender						
			Women		**Men**	
Sample Size			**307**		**129**	
Model Fit			**CMIN/df = 2.814, GFI: 0.981, CFI = 0.994, TLI = 0.970, NFI = 0.991, RMSEA = 0.065, p = 0.035**			
Path			**Estimate**	***p*-Value**	**Estimate**	***p*-Value**
Effort Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.278	***	0.409	***
Performance Expectancy	<–	E -Learning Self Efficacy	0.164	***	0.219	0.003
Performance Expectancy	<–	Perceived Learning Opportunities	0.556	***	0.488	***
Effort Expectancy	<–	Social Influence_	0.304	***	0.28	***
Performance Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.267	***	0.247	0.001
Effort Expectancy	<–	E-Learning Self-Efficacy	0.355	***	0.291	***
Intention to Use	<–	Social Influence	0.043	0.341	−0.106	0.206
Intention to Use	<–	Perceived Playfulness (Teachers' Perspective)	0.078	0.248	0.159	0.191
Intention to Use	<–	Perceived Playfulness (Students' Perspective)	0.027	0.672	0.173	0.17
Intention to Use	<–	Perceived Learning Opportunities	0.159	0.069	−0.029	0.852
Intention to Use	<–	Self-Management of Learning	−0.016	0.659	0.015	0.801
Intention to Use	<–	E-Learning Self-Efficacy	0.386	***	0.676	***
Intention to Use	<–	Performance Expectancy	0.171	0.037	-0.121	0.257
Intention to Use	<–	Effort Expectancy	0.079	0.139	0.13	0.212

*** p-value < 0.001.

Table A3. Factors affecting LMS adoption: regression analysis results for voluntariness of use.

Standardized Regression Weights: Voluntariness of Use						
			Yes		**No**	
Sample Size			**292**		**141**	
Model Fit			**CMIN/df = 2.636, GFI: 0.983, CFI = 0.995, TLI = 0.972, NFI = 0.991, RMSEA = 0.062, P = 0.091**			
Path			**Estimate**	***p*-Value**	**Estimate**	***p*-Value**
Effort Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.371	***	0.178	0.014
Performance Expectancy	<–	E-Learning Self-Efficacy	0.183	***	0.172	0.003
Performance Expectancy	<–	Perceived Learning Opportunities	0.514	***	0.575	***
Effort Expectancy	<–	Social Influence	0.314	***	0.334	***
Performance Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.275	***	0.227	***
Effort Expectancy	<–	E-Learning Self-Efficacy	0.272	***	0.458	***
Intention to Use	<–	Social Influence	−0.071	0.168	0.099	0.126
Intention to Use	<–	Perceived Playfulness (Teachers' Perspective)	0.123	0.083	0.013	0.895
Intention to Use	<–	Perceived Playfulness (Students' Perspective)	0.065	0.328	0.032	0.77
Intention to Use	<–	Perceived Learning Opportunities	0.063	0.467	0.311	0.037
Intention to Use	<–	Self-Management of Learning	−0.066	0.076	0.045	0.461
Intention to Use	<–	E-Learning Self-Efficacy	0.542	***	0.362	***
Intention to Use	<–	Performance Expectancy	0.083	0.273	0.085	0.46
Intention to Use	<–	Effort Expectancy	0.143	0.019	−0.001	0.986

*** *p*-value < 0.001.

Table A4. Factors affecting LMS adoption: regression analysis results for use.

Standardized Regression Weights: LMS Use						
			Yes		**No**	
Sample Size			**294**		**153**	
Model Fit		**CMIN/df = 2.238, GFI: 0.985, CFI = 0.996,**	**TLI = 0.980, NFI = 0.983, RMSEA = 0.053, *p* = 0.096**			
Path			**Estimate**	***p*-Value**	**Estimate**	***p*-Value**
Effort Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.349	***	0.243	***
Performance Expectancy	<–	E-Learning Self-Efficacy	0.165	***	0.219	***
Performance Expectancy	<–	Perceived Learning Opportunities	0.519	***	0.538	***
Effort Expectancy	<–	Social Influence	0.293	***	0.35	***

Table A4. *Cont.*

Standardized Regression Weights: LMS Use						
			Yes		No	
Sample Size			294		153	
Model Fit		CMIN/df = 2.238, GFI: 0.985, CFI = 0.996,	TLI = 0.980, NFI = 0.983, RMSEA = 0.053, p = 0.096			
Path			Estimate	p-Value	Estimate	p-Value
Performance Expectancy	<–	Perceived Playfulnes (Teachers' Perspective)	0.29	***	0.216	***
Effort Expectancy	<–	E-Learning Self-Efficacy	0.308	***	0.383	***
Intention to Use	<–	Social Influence	−0.049	0.339	0.115	0.065
Intention to Use	<–	Perceived Playfulness (Teachers' Perspective)	0.171	0.015	−0.104	0.282
Intention to Use	<–	Perceived Playfulness (Students' Perspective)	0.084	0.228	0.04	0.673
Intention to Use	<–	Perceived Learning Opportunities	0.112	0.212	0.323	0.012
Intention to Use	<–	Self-Management of Learning	−0.069	0.072	0.061	0.277
Intention to Use	<–	E-Learning Self-Efficacy	0.504	***	0.374	***
Intention to Use	<–	Performance Expectancy	0.025	0.75	0.13	0.203
Intention to Use	<–	Effort Expectancy	0.092	0.13	0.027	0.72

*** p-value < 0.001.

Table A5. Factors affecting LMS adoption: regression analysis results for experience.

Standardized Regression Weights: Experience												
			0–5 Years		6–10 Years		11–20 Years		21–30 Years		31 And Above	
Sample Size			85		83		153		84		40	
Model Fit			CMIN/df = 1.749, GFI: 0.972, CFI = 0.994, TLI = 0.971, NFI = 0.987, RMSEA = 0.041, p = 0.000									
Path			Estimate	p-Value	Estimate	p-Value	Estimate	p-Value	Estimate	p-Value	Estimate	p-Value
Effort Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.07	0.41	0.20	0.02	0.45	***	0.34	***	0.67	***
Performance Expectancy	<–	E-Learning Self-Efficacy	0.08	0.35	0.24	0.00	0.20	***	0.36	***	0.08	0.47
Performance Expectancy	<–	Perceived Learning Opportunities	0.55	***	0.38	***	0.62	***	0.42	***	0.51	0.01
Effort Expectancy	<–	Social Influence	0.28	0.00	0.41	***	0.27	***	0.46	***	0.12	0.20
Performance Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.34	***	0.36	***	0.18	0.00	0.21	0.01	0.34	0.08
Effort Expectancy	<–	E-Learning Self-Efficacy	0.60	***	0.37	***	0.24	***	0.12	0.21	0.20	0.03
Intention to Use	<–	Social Influence	0.11	0.15	0.01	0.93	0.06	0.36	−0.04	0.74	−0.13	0.38
Intention to Use	<–	Perceived Playfulness (Teachers' Perspective)	−0.04	0.68	0.05	0.75	0.04	0.67	0.35	0.01	0.19	0.55
Intention to Use	<–	Perceived Playfulness (Students' Perspective)	0.32	0.00	0.02	0.89	0.07	0.45	−0.13	0.39	-0.38	0.16
Intention to Use	<–	Perceived Learning Opportunities	0.26	0.11	0.26	0.13	−0.03	0.82	0.32	0.03	0.26	0.42
Intention to Use	<–	Self-Management of Learning	−0.04	0.45	−0.04	0.56	−0.05	0.34	−0.03	0.67	0.14	0.18
Intention to Use	<–	E-Learning Self-Efficacy	0.30	0.00	0.62	***	0.41	***	0.49	***	0.35	0.02
Intention to Use	<–	Performance Expectancy	0.15	0.17	−0.23	0.14	0.26	0.05	−0.01	0.93	0.26	0.19
Intention to Use	<–	Effort Expectancy	−0.08	0.35	0.18	0.14	0.16	0.06	−0.06	0.59	0.22	0.34

*** p-value < 0.001.

Table A6. Factors affecting LMS adoption: regression analysis results for age.

Standardized Regression Weights: Age									
			20–30		**31–40**		**41–50**		**51 and Above**	
Sample Size			**104**		**174**		**105**		**63**	
Model Fit			**CMIN/df = 2.031, GFI: 0.974, CFI = 0.993, TLI = 0.967, NFI = 0.988, RMSEA = 0.048, p = 0.004**							
Path			**Estimate**	***p*-Value**	**Estimate**	***p*-Value**	**Estimate**	***p*-Value**	**Estimate**	***p*-Value**
Effort Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.06	0.49	0.36	***	0.38	***	0.61	***
Performance Expectancy	<–	E-Learning Self-Efficacy	0.16	0.03	0.22	***	0.15	0.03	0.23	0.01
Performance Expectancy	<–	Perceived Learning Opportunities	0.51	***	0.46	***	0.57	***	0.64	***
Effort Expectancy	<–	Social Influence	0.32	***	0.32	***	0.24	0.00	0.27	0.00
Performance Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.31	***	0.30	***	0.26	***	0.08	0.43
Effort Expectancy	<–	E-Learning Self-Efficacy	0.56	***	0.29	***	0.32	***	0.08	0.35
Intention to Use	<–	Social Influence	0.06	0.34	0.06	0.39	0.09	0.33	−0.26	0.03
Intention to Use	<–	Perceived Playfulness (Teachers' Perspective)	0.09	0.28	0.06	0.61	0.08	0.51	0.32	0.10
Intention to Use	<–	Perceived Playfulness (Students' Perspective)	0.25	0.01	−0.03	0.72	0.10	0.38	−0.15	0.42
Intention to Use	<–	Perceived Learning Opportunities	0.32	0.03	0.06	0.63	0.06	0.65	0.20	0.40
Intention to Use	<–	Self-Management of Learning	−0.05	0.30	−0.01	0.80	−0.10	0.14	0.05	0.60
Intention to Use	<–	E-Learning Self Efficacy	0.31	0.00	0.56	***	0.47	***	0.42	***
Intention to Use	<–	Performance Expectancy	0.03	0.80	0.03	0.82	0.21	0.08	0.07	0.68
Intention to Use	<–	Effort Expectancy	−0.05	0.55	0.18	0.03	-0.01	0.92	0.20	0.19

*** p-value < 0.001.

Table A7. Regression analysis results for course type.

Standardized Regression Weights: Course Type											
			Primary Class		Social Sciences		Science and Math		Foreign Languages		Music, PE, Arts, and Other	
Sample Size			92		100		122		68		65	
Model Fit			CMIN/df = 2.038, GFI: 0.968, CFI = 0.992, TLI = 0.958, NFI = 0.985, RMSEA = 0.048, p = 0.000									
Path			Estimate	p-Value	Estimate	p-Value	Estimate	p-Value	Estimate	p-Value	Estimate	p-Value
Effort Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.46	***	0.40	***	0.19	0.02	0.21	0.08	0.20	0.04
Performance Expectancy	<–	E-Learning Self-Efficacy	0.09	0.09	0.18	0.03	0.13	0.07	0.25	0.00	0.36	***
Performance Expectancy	<–	Perceived Learning Opportunities	0.69	***	0.57	***	0.43	***	0.49	***	0.41	***
Effort Expectancy	<–	Social Influence	0.09	0.12	0.35	***	0.31	***	0.44	***	0.45	***
Performance Expectancy	<–	Perceived Playfulness (Teachers' Perspective)	0.21	0.00	0.20	0.01	0.40	***	0.26	0.00	0.21	0.03
Effort Expectancy	<–	E-Learning Self-Efficacy	0.44	***	0.18	0.02	0.46	***	0.29	0.02	0.29	0.00
Intention to Use	<–	Social Influence	−0.07	0.31	0.13	0.19	−0.06	0.56	0.08	0.40	−0.05	0.65
Intention to Use	<–	Perceived Playfulness (Teachers' Perspective)	0.24	0.08	−0.04	0.68	0.17	0.20	0.00	0.99	0.40	***
Intention to Use	<–	Perceived Playfulness (Students' Perspective)	0.08	0.54	−0.01	0.91	0.04	0.76	0.00	0.99	−0.05	0.68
Intention to Use	<–	Perceived Learning Opportunities	0.26	0.17	0.35	0.01	−0.05	0.79	-0.06	0.76	0.09	0.52
Intention to Use	<–	Self-Management of Learning	0.12	0.11	−0.10	0.05	0.00	0.99	-0.09	0.27	0.14	0.05
Intention to Use	<–	E-Learning Self-Efficacy	0.24	0.01	0.33	***	0.49	***	0.72	***	0.69	***
Intention to Use	<–	Performance Expectancy	−0.06	0.70	0.24	0.02	0.06	0.68	0.06	0.74	−0.17	0.16
Intention to Use	<–	Effort Expectancy	0.14	0.18	0.00	1.00	0.22	0.05	0.17	0.13	−0.05	0.64

*** p-value < 0.001.

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