

The extended technology acceptance model for Web 2.0 technologies in teaching

El modelo de aceptación de tecnología extendida para las tecnologías Web 2.0 en la enseñanza

RECIBIDO 23/09/2022 ACEPTADO 12/10/2022 PUBLICADO 01/12/2022

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ABSTRACT

Web 2.0-based learning enables collaborative learning and knowledge sharing and makes an important contribution to student learning. This study extended the original Technology Acceptance Model (TAM) by considering the effects of tool literacy, metacognitive self-regulation, subjective norm, facilitating conditions, and institutional support to understand pre-service teachers' intentions to use Web 2.0 technology in their courses. The sample data of 318 responses were from pre-service teachers. Structural equation modeling results showed a good fit for the extended model, indicating that metacognitive self-regulation and subjective norm had a significant influence on perceived ease of use and perceived usefulness, while institutional support and enabling conditions were not significantly associated with them. In addition, perceived ease of use and perceived usefulness influenced attitude, which in turn had a significant effect on intention. Furthermore, perceived ease of use, perceived usefulness, and attitude acted as significant mediators of behavioral intention. The indirect effect of perceived ease of use on perceived usefulness and attitude, and the indirect effect of perceived usefulness on attitude were also significant. Overall, the current study helps researchers and practitioners better understand future teachers' intentions to use Web 2.0 technologies in their courses.

KEYWORDS Technology acceptance, pre-service teachers, Web 2.0, intention, tool literacy, metacognitive self-regulation.

RESUMEN

El aprendizaje basado en Web 2.0 permite el aprendizaje colaborativo y el intercambio de conocimientos y hace una importante contribución al aprendizaje de los estudiantes. Este estudio amplió el original Modelo de Aceptación de Tecnología (con siglas en inglés TAM) al considerar los efectos de la alfabetización de herramientas, la autorregulación metacognitiva, la norma subjetiva, las condiciones facilitadoras y el apoyo institucional para comprender las intenciones de los futuros maestros de usar la tecnología Web 2.0 en sus cursos. Los datos de la muestra fueron 318 futuros maestros. Los resultados del modelo de ecuaciones estructurales mostraron un buen ajuste para el modelo extendido, lo que indica que la autorregulación metacognitiva y la norma subjetiva tenían una influencia significativa en la facilidad de uso percibida y la utilidad percibida, mientras que el apoyo institucional y las condiciones favorables no se asociaron significativamente con ellos. Además, la facilidad de uso percibida y

la utilidad percibida influyeron en la actitud, que a su vez tuvo un efecto significativo en la intención. También la facilidad de uso percibida, la utilidad percibida y la actitud actuaron como mediadores significativos de la intención de comportamiento. El efecto indirecto de la facilidad de uso percibida sobre la utilidad percibida y la actitud, y el efecto indirecto de la utilidad percibida sobre la actitud también fueron significativos. En general, el estudio actual ayuda a los investigadores y profesionales a comprender mejor las intenciones de los futuros docentes de utilizar las tecnologías Web 2.0 en sus cursos.

PALABRAS CLAVE Aceptación de tecnología, futuros docentes, Web 2.0, intención, alfabetización de herramientas, autorregulación metacognitiva.

1. INTRODUCTION

Web 2.0 technologies called as “a wide array of web-based applications which allow users to collaboratively build content and communicate with others across the world.” (Butler, 2012, p. 139) has been used frequently in many areas of daily life. Web 2.0 technology based on a social software activates a technology based architectural field and provides users to communicate anytime and anywhere (Olaniran, 2009; Su et al., 2010). Blogs, wikis, social bookmarking, and social networking sites are among the most used Web 2.0 technologies (Sadaf et al., 2012a). Web 2.0 technology enables users to create their own products and simply read the content and transform the online environment from an information-heavy archive into a participatory platform (Lim, & Newby, 2021). Over time, individuals began to use Web 2.0 technology not only for personal purposes, but also to support and improve learning and teaching process (Jimoyiannis, 2013). Web 2.0 based learning provides collaborative learning and knowledge sharing (Chen et al., 2012). With the widespread use of Web 2.0 technologies in the learning process, its use in teacher education has also increased in recent years (Hursen, 2021; Lim, & Newby, 2021). At the basis of this prevalence is the high potential of Web 2.0 technologies to effectively improve teaching (Shihab, 2008) and extend the teaching environment from schools to homes or wider communities (Jimoyiannis, 2010). Web 2.0 technologies can be used in different types of teaching environments such as face-to-face learning (Hursen, 2021), blended learning (Olpak, & Ateş, 2018), and formal and informal education (Faizi, 2018). However, previous studies showed that teachers encounter some problems such as creative thinking, lack of motivation, and distraction while experiencing Web 2.0 technology in teaching (Lim, & Newby, 2021) although teachers’ concerns, beliefs, attitudes and motivations are of great importance for effective teaching through Web 2.0 technologies (Teo et al., 2019).

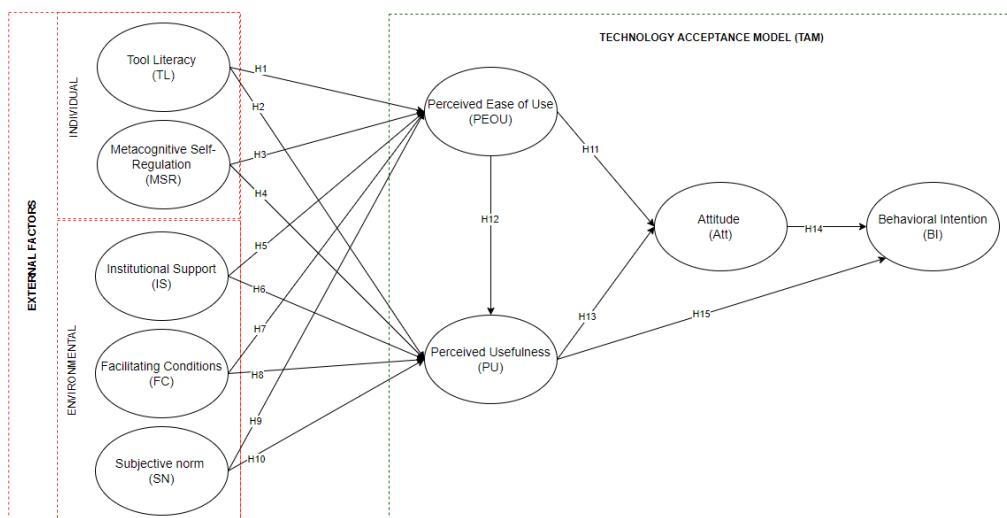
With the growing availability of Web 2.0 technologies in the educational fields, there has been a considerable increase in the number of studies examining teacher behaviors. Therefore, an understanding of teachers’ teaching behaviors through Web 2.0 technologies is essential in developing effective educational strategies that cause positive teaching implications. However, although a Web 2.0 technologies may provide important benefits, many teachers so not use it wisely due to several reasons such as inability to keep up with technology, unfavorable physical conditions and lack of time to allocate. Recent studies showed that young people tend to use Web 2.0 technology better than older people (China Internet Network Information Centre, 2016), so this study focused on intentions’ of future teachers, pre-service teachers who do not have teaching experience. Previous studies indicated that pre-service teachers’ intentions to use educational technologies was found to be an important determinant of successful integration in their courses in the future (Sungur-Gül, & Ateş, 2021). Specifically, an examination of the understanding factors affecting pre-service teachers’ intentions to use Web 2.0 technology in their courses may provide important insights into their

teaching process. Given this, the present study employed the Technology Acceptance Model (TAM) (Davis, 1989) to understand pre-service teachers' intentions to use Web 2.0 technology in their courses. The TAM has strong predictive power for technology acceptance in a great variety of education-based studies (Teo, & Dai, 2022) and allows for inclusion of different variables such as belief-related, individual, social, volitional, and non-volitional factors in the model (Teo et al., 2019). Modifying the TAM model by adding, broadening and deepening various external constructs often contribute to enhancing the prediction ability for intentions in educational context (Ateş, & Garzon, 2022a). In recent years, there has been increasing research examining the effect of individual factors such as tool literacy (TL) and metacognitive self-regulation (MSR) which play an important role for integration of information and communications technology for learning and teaching (Lim, & Newby, 2021) will help to gain a new perspective. Similarly, social factors such as subjective norm (SN), facilitating conditions (FC), and institutional support (IS) on intention to use educational technology has been affectively used in recent studies (Abdullah, & Ward, 2016; Huang et al., 2021). Therefore, the present study aimed to extend the TAM by adding TL, MSR, SN, FC, and IS as external factors to improve the ability to understand pre-service teachers' intention to use Web 2.0 technologies.

1.1. Purpose of the study

The TAM has been used in various educational technology studies, but there are no so many studies conducting this model to explain pre-service teachers' intention to use Web 2.0 technologies to teach in their courses in future (Sadaf et al., 2016; Teo et al., 2019). In addition, within our knowledge, no study has used some additional constructs including TL, MSR, SN, FC, and IS to predict intention, particularly in Turkish context. We believe that there is an important need for a new study on the use of Web 2.0 technology in teacher education, which has become more widespread worldwide, especially after COVID-19 (Torrás Virgili, 2021; Vargo et al., 2021). Overall, the current study aimed to test the applicability of TAM by adding above-mentioned construct. The modified TAM model proposed within the conceptual framework is involved in Figure 1. The model includes the original variables of the TAM and additional constructs (TL, MSR, SN, FC, and IS). The lines shown in red show the newly added constructs on the original TAM.

FIGURE 1. Conceptual framework



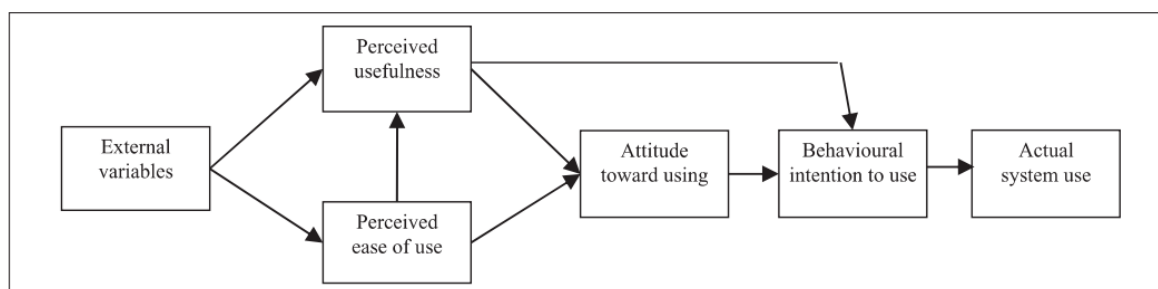
1.1. Theoretical background and research hypothesis

1.1.1. Technology Acceptance Model

According to Davis (1989), user acceptance plays important role for successful technology implementation. Based on this thought, the technology acceptance model (TAM) originated from the theory of reasoned action and the theory of planned behavior (Wang et al., 2022a) were developed by Davis (1989) to individuals' acceptance or rejection of a technology. The model postulated that system design features has a positive effect on perceived ease of use (PEOU) and perceived usefulness (PU). PEOU influence PU and attitude (ATT) and actual use of people is influenced by ATT (Davis, 1993).

The TAM has been applied successfully in context of educational areas across a wide range of technology platforms and different cultures (Abdullah, & Ward, 2016). For example, Al-Dokhny et al. (2021) study purposed to understand factors influencing the intentions to use distance education platforms in Saudi Arabia and found that TAM is suitable to predict intentions to use this education platform. Similar studies were conducted by Fussell and Truong (2021) in the U.S, and Zhou et al. (2022) in China using the TAM as the theoretical framework.

FIGURE 2. Technology Acceptance Model



1.2. Hypotheses development

This section includes how predictors are associated with intentions and how external factors are related to constructs of original TAM. The constructs are explained and empirical studies supporting proposed relationships are mentioned in following sections.

1.2.1. Perceived ease of use (PEOU)

PEOU can be defined as refers to “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989, p. 320). TAM postulated that PEOU has affects PU and ATT as well as indirect effect on behavioral intention (BI) to use technology (Zhou et al., 2022). Considering the educational technology, recent studies has confirmed the effect of PEOU on ATT and PU in a range of educational technologies. However, there is an insufficient number of studies explaining

pre-service teachers' ATTs and intention to use Web 2.0 technologies in their future teaching (Sadaf et al., 2016; Teo et al., 2019). Therefore, we proposed that if pre-service teachers perceive that using Web 2.0 technology to teach is free of effort, they believe the usefulness of this technology and positive evaluations about using Web 2.0 technology in teaching process.

1.2.2. Perceived usefulness (PU)

PU refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). According to TAM, PU has a positive effect on ATT and intention to use the technology (Zhou et al., 2022). Similarly, in the educational technology context that many studies have documented PU an important predictor of ATT and intention including mobile technology acceptance (Sungur-Gül, & Ateş, 2021), augmented reality (Papakostas et al., 2022), and adoption of CCTalk (Wang et al., 2022b). Based on these findings, we assume that if pre-service teachers believe that using Web 2.0 technologies increase their performance, their ATTs and intentions to use this technology in education will also increase.

1.2.3. Attitude (ATT)

ATT is the degree to which people have a positive or negative evaluations when they act a certain behavior (Ajzen, 1991). In this regard, when ATT is incorporated into educational technology system, recent studies indicated that ATT has significantly affect intentions to use technology in education (Wang et al., 2022a). One of the very rare studies on Web 2.0 technologies was conducted by Sadaf et al. (2016). The results of the study revealed that ATT significantly predicted preservice teachers' intentions to use Web 2.0 technologies in the classroom. Therefore, it is supposed that pre-service teachers with a more positive ATT towards the use Web 2.0 technologies will have higher intention to use this technology in their future teaching.

1.2.4. External Factors

1.2.4.1. Subjective Norm (SN)

SN refers to "the perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991, p. 188). Family members, colleagues, and friends can be included in this 'others' group (Taufique, & Vaithianathan, 2018). This study divided SNs into three groups: Students, colleagues, and administrators who are supposed to support the use of Web 2.0 technologies in teaching as Sadaf et al. (2012b) decomposed. Recent empirical studies showed that SN was found to be important predictor intention on PEOU and PU in educational technologies.

1.2.4.2. Tool literacy (TL)

TL refers to "the ability to understand and use the practical and conceptual tools of current information technology, including software, hardware and multimedia, that are relevant to education and the areas of work and professional life" (Shapiro, & Hughes, 1996, p. 4). TL has been accepted that

it is an effective factor in the technology-based learning and teaching process within a wide range of research frameworks (Lim, & Newby, 2021; Yu et al., 2017). For example, Rahimi et al. (2015) found that students and teachers do not feel sufficient in terms of motivation due to the technological challenges. Similarly, Lim and Newby (2020) emphasized the importance of TL for effective technology teaching for pre-service teachers. In relation to the study context, Lim and Newby (2021) stated that the ability to use Web 2.0 technologies was suggested as important precondition for achieving successful to ensure a successful learning environment for pre-service teachers. Accordingly, since TL was perceived an important motivation construct for Web 2.0 technologies, we assume that pre-service teachers' TL may play an essential role on their beliefs toward ease of use and usefulness of Web 2.0 technologies.

1.2.4.3. Metacognitive Self-Regulation (MSR)

Self-regulation is defined as “self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals” (Zimmerman, 2000, p. 14). Self-regulated learning consists of four phases including making adaptations to metacognition, studying tactics, goal-setting and planning and task definition (Winne, & Hadwin, 1998), while Zimmerman (1998) emphasized three cyclic phases including pre-actional phase actional phase and post-actional phase. According to Winne (2011), individuals who are self-regulated learner tend to be active cognitively and metacognitively. Tu et al. (2015) stated that educators have an important role to play in providing their students' self-regulation skills. In the context of Web 2.0 technologies, pre-service teachers with high metacognitive self-regulated learning levels are more successful and have higher ATTs towards using this technology (Lim, & Newby, 2021; Yen et al., 2013). In this direction, considering the high relationship between ATT and PEOU and usefulness in recent technology acceptance studies with pre-service teachers (Ateş, & Garzon, 2022a; Sungur Gül, & Ateş, 2021), it is necessary to hypothesize that MSR beliefs are positively related to their PEOU and usefulness beliefs.

1.2.4.4. Facilitating Conditions (FC)

FC refers to “the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system” (Venkatesh et al., 2003, p. 453). This construct examines individuals' views about physical environment such as provision of computer support and infrastructure (Camilleri, & Camilleri 2022; Thompson et al., 1991). We can define this construct in the scope of the current study as the degree to which pre-service teachers think that there is the existence and availability of people they can get help with, someone to teach them, access to necessary resources to support the use of Web 2 technologies. In studies conducted by teachers, it was revealed that FC play an important role on teachers' use of technology (Ateş, & Garzon, 2022b). In addition, some of earlier studies found that pre-service teachers' perceptions related to FC had a vital importance on some beliefs about ease of use and usefulness (Huang et al., 2021; Teo et al., 2019).

1.2.4.5. Institutional Support (IS)

Teachers' use of technology in their lessons makes a great contribution to optimizing students' learning (Adov, & Mäeots, 2021). However, some environmental factors have important effects on the

inclusion of technology in the lessons. One of them is the IS. A person's use of a particular technology in the workplace can be changed according to how much support the person receives while using the technology (Park et al., 2014). In the framework of the study, the construct of IS examines pre-service teachers' views about school administrators related to vision, support, and help in the using of technology (Khlaisang et al., 2021). IS has been explained in earlier studies as an important variable that indicates help or barriers to technology usage in workplace (Huang et al., 2020). In addition, in case of lack of IS, it will negatively affect the opinions of individuals about technology being useful or easy to use (Park et al., 2014). Empirically, IS was found to have an important construct on PEOU and PU in earlier technology acceptance studies (Park et al., 2014). However, due to the lack of studies with pre-service teachers, evaluating the thoughts of future teachers with the current study in this context will make important contributions to the literature.

1.3. Research hypotheses

Based on the above-mentioned conceptual framework, the following 15 were proposed:

- H_1 : TL has a positive influence on the PEOU of Web 2.0 technologies.
- H_2 : TL has a positive influence on the PU of Web 2.0 technologies.
- H_3 : MSR has a positive influence on the PEOU of Web 2.0 technologies.
- H_4 : MSR has a positive influence on the PU of Web 2.0 technologies.
- H_5 : IS has a positive influence on the PEOU of Web 2.0 technologies.
- H_6 : IS has a positive influence on the PU of Web 2.0 technologies.
- H_7 : FC have a positive influence on the PEOU of Web 2.0 technologies.
- H_8 : FC have a positive influence on the PU of Web 2.0 technologies.
- H_9 : SN has a positive influence on the PEOU of Web 2.0 technologies.
- H_{10} : SN has a positive influence on the PU of Web 2.0 technologies.
- H_{11} : PEOU has a positive influence on the ATT toward using Web 2.0 technologies.
- H_{12} : PEOU has a positive influence on the PU of Web 2.0 technologies.
- H_{13} : PU has a positive influence on the ATT toward using Web 2.0 technologies.
- H_{14} : ATT has a positive influence on the intention to use Web 2.0 technologies.
- H_{15} : PU has a positive influence on the intention to use Web 2.0 technologies.

2. MATERIAL AND METHOD

2.1. Participants

The research group consisted of 318 teacher candidates (78% female, 22% male) who participated in the research with the convenience sampling method. Taking into account the variables of the institution and

peer support, it was ensured that the participants were at different universities, departments, and years. According to their percentages, the research group consisted of pre-service teachers in Primary School (51%), Mathematics (25%), Science (10%), Social Studies (8%), and English (6%). The participants are mostly junior (77%). Additionally, pre-service teachers were asked about their experience of using Web 2.0 instructional technologies. The participants described their experiences with Web 2.0 technologies as “informed and experienced” (62%), “informed but inexperienced” (21%), and “uninformed and inexperienced” (17%).

2.2. Measures

The research variables were measured using an online questionnaire with 5-point Likert items (1, strongly disagree to 5, strongly agree) given in Table 1. Participants responded to 40 items on tool literacy (TL) (Lim, & Newby, 2021; Ng, 2012), metacognitive self-regulation (MSR) (Lim, & Newby, 2021; Pintrich et al., 1991), facilitating conditions (FC) (Lai, 2015; Teo, 2009; Teo et al., 2019; Thompson et al., 1991), institutional support (IS) (Khlaisang et al., 2021; Lai, & Chen, 2011), subjective norm (SN) (Ajzen, 2006; Ajjan, & Hartshorne, 2008; Teo et al., 2019; Venkatesh, & Davis, 2000), perceived ease of use (PEOU) (Davis, 1989; Teo et al., 2019), perceived usefulness (PU) (Davis, 1989; Teo et al., 2019), attitude (Att) (Davis, 1989; Khlaisang et al., 2021), and behavioral intention (BI) (Ajzen, 2006; Armenteros et al., 2013; Davis, 1989; Teo et al., 2019) to use Web 2.0 technologies. Table 1 shows that the AVE values of the observed variables is ranging from .63 to .81, which is also above the acceptable limit of .5 (Hair et al., 2019). Further, composite reliability (CR) values are given to evaluate the construct reliability of the measurement models. The CR values are above than the recommendation value of .60 (ranges from .87 to .93) (Hair et al., 2019).

TABLE 1. The validity and reliability of the measurement variables

	FACTOR LOADING
TOOL LITERACY (CR=.89, AVE=.64)	
I can learn new tools easily. (TL01)	.48
I keep up with important new tools. (TL02)	.50
I know how to solve my technical problems concerning computer software and hardware (TL03)	.55
I am good at using Web 2.0 tools (TL04)	.87
I know about a lot of different Web 2.0 tools (TL05)	.86
I have the skills to choose appropriate Web 2.0 tools according to learning context (e.g., purpose, subject, activities) (TL06)	.89
I am good at applying Web 2.0 tools to promote performance or learning (TL07)	.93
METACOGNITIVE SELF-REGULATION (CR=.91, AVE=.68)	
When I study something by myself, I try to find the best way to learn it. (MSR01)	.87
When I study something by myself, I try to analyze my learning style to find a more effective way of studying. (MSR01)	.83
When I study, I ask myself questions to make sure I understand the material I have been studying. (MSR01)	.82

When I study, I try to determine which concepts or principles I don't understand well. (MSR01)	.85
When I study, I set goals for myself to direct my activities in each study period. (MSR01)	.76
Subjective norm (CR=.97, AVE=.63)	
People who are important to me support me to use Web 2.0 tools in teaching. (SN01)	.78
My students will support my use of Web 2.0 tools in teaching. (SN02)	.86
Schools support the use of Web 2.0 tools in teaching. (SN03)	.75
FACILITATING CONDITIONS (CR=.90, AVE=.69)	
When I need help to use Web 2.0 tools in teaching, someone will be there to help me. (FC01)	.87
When I need help to learn to use Web 2.0 in teaching, someone will be there to teach me. (FC02)	.91
I will have the resources necessary to teach with the Web 2.0 tools. (FC03)	.79
Training for using Web 2.0 tools in teaching will be available for me. (FC04)	.75
INSTITUTIONAL SUPPORT (CR=.95, AVE=.81)	
The institution is committed to the vision of using Web 2.0 tools in learning (IS01)	.79
The institution is committed to support my efforts in learning with Web 2.0 tools. (IS02)	.91
The institution strongly encourages the use of learning with Web 2.0 tools. (IS03)	.92
The institution recognizes my efforts in learning with Web 2.0 tools. (IS04)	.91
Learning with Web 2.0 tools is important to the institution. (IS05)	.93
Perceived ease of use (CR=.87, AVE=.64)	
Learning to use Web 2.0 tools in teaching will be easy. (PEOU01)	.83
Using Web 2.0 tools in teaching will be clear and understandable. (PEOU02)	.87
Using Web 2.0 tools in teaching will be flexible to interact with. (PEOU03)	.61
It will be easy to become skillful at using Web 2.0 tools in teaching. (PEOU04)	.85
Perceived usefulness (CR=.93, AVE=.78)	
USING WEB 2.0 TOOLS WILL IMPROVE MY TEACHING PERFORMANCE. (PU01)	
Using Web 2.0 tools will enhance my teaching effectiveness. (PU02)	.94
Using Web 2.0 tools will increase my productivity in my teaching. (PU03)	.93
Web 2.0 tools will be useful for my teaching. (PU04)	.74
Attitude (CR=.89, AVE=.74)	
Web 2.0 tools make learning more interesting. (Att01)	.95
Learning with Web 2.0 tools is fun. (Att02)	.96
I like to use Web 2.0 tools. (Att03)	.71
BEHAVIORAL INTENTION (CR=.93, AVE=.78)	
I plan to use Web 2.0 tools often in my future teaching. (BI01)	.87
I intend to use Web 2.0 tools as much as possible in my future teaching. (BI02)	.88
I will talk about the positive aspects of using Web 2.0 tools in my future classroom. (BI03)	.90
I will recommend Web 2.0 tools to my future colleagues. (BI04)	.88

2.3. Data analysis

The proposed model called the extended TAM for Web 2.0 technologies in teaching is specified in Fig.1. The model includes a total of nine observed variables involving fifteen paths. In the proposed research model, PEOU and PU are positively influenced by the pre-service teacher’s individual (TL, MSR) and environmental (FC, IS, SN) background characteristics. A pre-service teacher’s intention to use the Web 2.0 technologies in teaching is formulated by PEOU, PU, and ATT towards using Web 2.0 technologies in teaching. The analyses were performed using the maximum likelihood estimation approach in AMOS (v.22). The model fit indices were reported including RMSEA, SRMR, CFI, and TLI.

3. RESULTS

3.1. Descriptive statistics

Table 2 shows the descriptive statistics of pre-service teachers’ observed variables. The class width in 5-point Likert data is 1.33 when the number of classes is set as three. So, the scale mean values were interpreted as low ($X \leq 2.33$), medium ($2.33 < X \leq 3.66$), and high ($X > 3.66$) using the class width. It was seen that the pre-service teachers had high scale averages for the PEOU (3.83), PU (4.24), ATT (4.11), and BI (4.06) which are components of the TAM to use Web 2.0 technologies. When the averages of the participants for the individual external factors in the model were examined, it was determined that the MSR level was high with an average of 4.02, and the TL level was moderate with a mean of 3.42. For the environmental external factors in the model, it was seen that the participants were distributed with a moderate average. The skewness and kurtosis values indicate that the distributions obtained for the observed variables have a distribution close to normal (in the range of -2 to +2).

TABLE 2. Descriptive statistics of the observed variables

	M	SD	SKEWNESS	KURTOSIS
Perceived ease of use	3.83	0.75	-0.80	1.22
Perceived usefulness	4.24	0.79	-1.06	1.01
Attitude	4.11	0.89	-1.16	1.14
Behavioral intention	4.06	0.84	-1.03	0.98
Tool literacy	3.23	0.81	-0.01	-0.53
Metacognitive self-regulation	4.02	0.79	-1.28	2.21
Institutional support	3.43	0.99	-0.54	-0.21
Facilitating conditions	3.36	0.96	-0.31	-0.50
Subjective norm	3.63	0.89	-0.74	0.46

Table 3 presents the bivariate Pearson correlations among the model variables. The results showed that the TAM components were significantly moderately correlated with each other in the range of .60 to .69. The external factors are correlated with each other in the range of .24 to .59, and the external factors were significantly moderately associated with the components of the TAM in the range of .30 to .53. The relationships among the observed variables do not indicate a possible multicollinearity problem. Table 2 shows that the root square of AVE is higher than the correlations among the observed constructs which implies that each construct is distinctive from the others.

TABLE 3. Results of discriminant validity

	PEOU	PU	ATT	BI	TL	MSR	IS	FC	SN
PEOU	.799								
PU	.615**	.886							
ATT	.604**	.693**	.861						
BI	.637**	.664**	.647**	.885					
TL	.529**	.355**	.445**	.528**	.797				
MSR	.311**	.373**	.318**	.287**	.239**	.824			
IS	.413**	.327**	.341**	.362**	.390**	.269**	.897		
FC	.445**	.311**	.298**	.308**	.414**	.267**	.531**	.829	
SN	.476**	.438**	.467**	.442**	.386**	.245**	.461**	.587**	.795

Notes: The diagonal line shows the root square of AVE.
 The other values represent the correlation between the constructs. **p<.001

3.2. Summary of SEM results

The results of SEM with the maximum likelihood estimation indicate that the proposed model fits the data well (TLI=.941, GFI=.951, IFI=.942, TLI=.806, SRMR=.059, RMSEA=.116, chi-square/df=7.60). The value of the relative fit indices (TLI, GFI, IFI) was above .90. The SRMR which is the absolute fit indices was noted which meets the suggested criterion of .08 (Hu, & Bentler, 1999). In Figure 2, non-significant regression coefficient in the SEM model are presented in red.

As shown in Fig 2 and Table 4, H₁, H₃, and H₉ posited that PEOU positively influenced by TL, MSR, SN were confirmed (H₁=.34, H₃=.13, H₉=.21; p < .001). Further, H₄ and H₅ posited that PU positively influenced by MSR and SN were also confirmed (H₄=.34, H₅=.13, H₉=.21; p < .001). However, the regression coefficients values which defined from environmental external factors (IS and FC) to both PEOU and PU were small and insignificant. Thus, H₂, H₅, H₆, H₇, and H₈ were rejected. The hypotheses defined on the basis of the TAM for Web 2.0 technologies in teaching were supported (H₁₁=.29, H₁₂=.49, H₁₃=.52, H₁₄=.42, H₁₅=.36; p<.001).

FIGURE 3. The path diagram of the proposed model

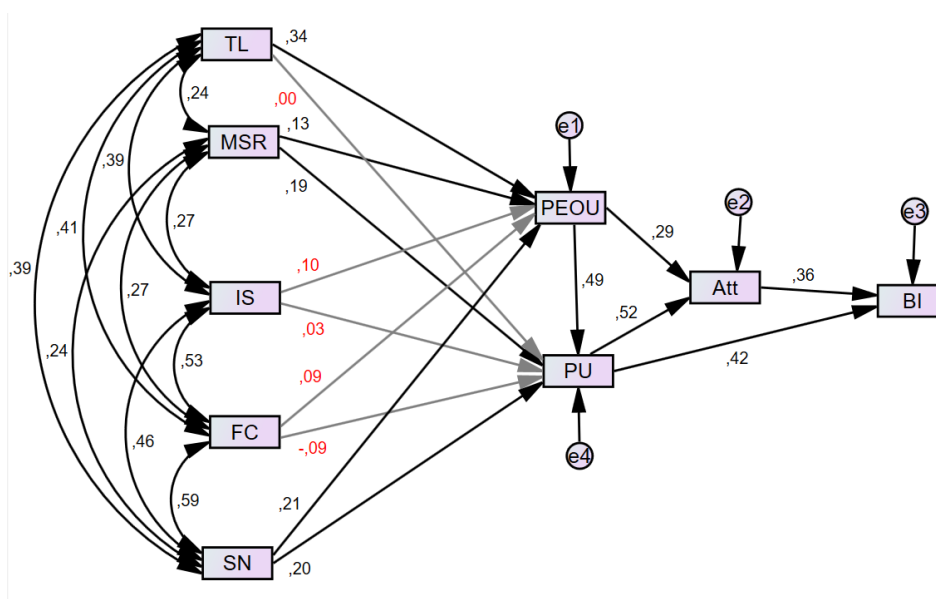


TABLE 4. Results of the hypotheses of the SEM model

	B	RESULT
H ₁ Direct effect of TL on PEOU	.34	Supported
H ₂ Direct effect of TL on PU	.00	Not Supported
H ₃ Direct effect of MSR on PEOU	.13	Supported
H ₄ Direct effect of MSR on PU	.19	Supported
H ₅ Direct effect of IS on PEOU	.10	Not Supported
H ₆ Direct effect of IS on PU	.03	Not Supported
H ₇ Direct effect of FC on PEOU	.09	Not Supported
H ₈ Direct effect of FC on PU	-.09	Not Supported
H ₉ Direct effect of SN on PEOU	.21	Supported
H ₁₀ Direct effect of SN on PU	.20	Supported
H ₁₁ Direct effect of PEOU on Att	.29	Supported
H ₁₂ Direct effect of PEOU on PU	.49	Supported
H ₁₃ Direct effect of PU on Att	.52	Supported
H ₁₄ Direct effect of ATT on BI	.42	Supported
H ₁₅ Direct effect of PU on BI	.36	Supported

Table 5 shows the standardized direct, indirect, and total effects of the model variables, as well as the squared values of the multiple correlations for each outcome variable. It was found that BI was significantly determined by PU and ATT, resulting in an R² of 0.512. This means that PU and ATT toward using Web 2.0 technologies explained 51% of the variance in BI. PU and PEOU, the components of TAM, explained 54% of the variance in ATTs toward using Web 2.0 technologies. Both PU and PEOU were significantly determined by external factors (IS, SN, FC, TL, and MSR) with R²=0.419 and R²=0.389, respectively. The results show that external factors accounted for 42% of the variance in PU and 39% of the variance in PEOU. The results showed that PU was the most important determinant of BI when considering total effect. ATT, PEOU, SN, MSR, and TL were significant determinants with a total effect of .331, .327, .202, .171, and .129, respectively. FC and IS were not significant determinants of BI.

TABLE 5. Direct, indirect, and total effects of the SEM model

OUTCOME	DETERMINANT	STANDARDIZED ESTIMATES		
		DIRECT	INDIRECT	TOTAL
Behavioral intention (R ² =0.512)	ATT	.331	-	.331
	PU	.439	.204	.643
	PEOU	-	.327	.327
	IS	-	.069	.069
	SN	-	.202	.202
	FC	-	-.018	-.018
	MSR	-	.171	.171
	TL	-	.129	.129
Attitude (R ² =0.540)	PU	.614	-	.614
	PEOU	.185	.254	.439
	IS	-	.076	.076
	SN	-	.217	.217
	FC	-	-.003	-.003
	MSR	-	.174	.174
	TL	-	.169	.169
Perceived usefulness (R ² =0.419)	PEOU	.413	-	.413
	IS	.068	.032	.100
	SN	.217	.079	.296
	FC	-.087	.048	-.039
	MSR	.222	.035	.258
	TL	.014	.151	.166
Perceived ease of use (R ² =0.389)	IS	.078	-	.078
	SN	.192	-	.192
	FC	.115	-	.115
	MSR	.086	-	.086
	TL	.366	-	.366

4. DISCUSSION

This study attempted to examine the extended model of technology acceptance developed for pre-service teachers' intentions regarding the use of Web 2.0 technologies. The results showed that the extended TAM with TL, MSR, and SN was valid for pre-service teachers' intentions to use Web 2.0 technologies.

MSR was found to have a significant direct effect on PU and PEOU. Based on this result, it can be predicted that pre-service teachers who have high MSR are more likely to have higher PU and PEOU when using Web 2.0 technologies. Considering the earlier studies, Lim and Newby (2020) showed that MSR was a significant predictor of preservice teachers' positive ATTs toward Web 2.0 technologies. In another study, it was found that there was a moderate relationship between self-regulation and PU in the context of the e-learning environment (Liaw, & Huang, 2013). Accordingly, the results of the present study are consistent with the findings of previous studies. One of the original findings of the study was that MSR was an essential determinant of PEOU.

TL, another individual external factor, had a significant direct effect on PU, but its effect on PEOU was not significant. There is no study that includes TL as an external factor in the TAM. Lim and Newby (2021) noted that the ability to use Web 2.0 technologies has been suggested as an important prerequisite for a successful learning environment for pre-service teachers. Another study has shown that experience with a particular technology plays an important role in the intention to use it (Pituch, & Lee, 2006). Considering the limited literature, it can be said that TL is the external variable that has a significant effect on PU in the extended TAM. In the light of all the findings mentioned above, the results of the current study made significant contributions to the literature on teachers' intentions to use Web 2.0 technologies.

While the direct effect of SN on PU and PEOU was significant, the direct effect of FC and IS on PU and PEOU was not found as significant. In previous studies, the direct effect of SN on teachers' PU of computer technologies was significant (Li et al., 2019; Teo, 2010). In this regard, the findings related to SN are supported by the literature. Unlike previous studies, this study focuses on the use of Web 2.0 technologies in education and also examines the effect of SN on PEOU. The results showed that both the direct effect of SN on PU and PEOU and its indirect effect on BI are significant. In studies that examined the direct effect of SN on BI, SN was found to be the most important determinant of BI (Teo, 2012). Based on these results, it can be stated that SN related to Web 2.0 technologies directly supports teachers' PU and PEOU and indirectly promotes their intention to use.

While the direct effect of SN on PU and PEOU was significant, the direct effect of FC and IS on PU and PEOU was not significant. In previous studies, the direct effect of SN on teachers' PU of computer technologies was significant (Li et al., 2019; Teo, 2010). In this regard, the findings related to SN are supported by the literature. Unlike past studies, this study focuses on the use of Web 2.0 technologies in education and also examined the effects of SN on PEOU. The results showed that both the direct effect of SN on PU and PEOU and its indirect effect on BI were significant. In studies that examined the direct effect of SN on BI, SN was found to be the most important determinant of BI (Teo, 2012).

Contrary to our expectations, the hypotheses (about FC and IS) based on previous studies (Teo, 2010) were not supported. While the direct effect of FC on PEOU was significant in a study by Teo (2010), it was not significant in another study by Teo (2012), although a similar model was tested. More recent studies confirm that the direct effect of FC on PEOU is not significant (Teo et al., 2019). The fact that access to information is much easier today than in the past may be the reason why the effect of FC on PU and PEOU is not as strong as in the past. Especially during the COVID-19 process, access to information has become easier and faster, and this has helped individuals not to depend on external resources and conditions in accessing information. A review of the literature revealed that the results of studies in which FC are added as a determinant of PU and PEOU to the TAM are confusing, while the results of studies in which BI is defined as a determinant are more consistent (Teo, 2010; Teo et al., 2019). Further research is needed on this topic.

The literature that includes IS as an external factor in the TAM is not as extensive as the FC. The conclusion that the direct effect of IS on PU and PEOU is not significant which is consistent with similar research findings (Alenezi et al., 2011). However, recent studies found that IS can be a significant moderator of the relationship between PEOU and ATT (Dangi, & Saat, 2021). In another study, IS was included as a predictor of SN in the TAM (Huang et al., 2020). There is no consensus in the literature on IS what role it plays in the TAM.

5. CONCLUSIONS

This study has several educational and practical implications for policy makers and teacher educators. Given the influence of TL on intentions to use Web 2.0 technologies, we suggest that courses to improve TL of pre-service teachers should be included in the curriculum. The second important conclusion from our findings concerns pre-service teachers' metacognitive self-regulation skills. Web 2.0 technologies are tools that are constantly evolving and changing. On the other hand, it's well known that students can ignore the ICT resources and pedagogical opportunities available to them (Padilla-Hernandez et al., 2019). Therefore, it's clear that individuals who want to use these technologies need skills in self-directed learning and self-regulation. Delen and Liew (2016) found that self-regulation can play an important role in online learning environments. For this reason, it's believed that it would be beneficial to develop teachers' self-regulation skills.

This study found that the extended TAM with external variables (TL, MSR, and SN) was confirmed to understand teachers' intentions to use Web 2.0 technologies. It was found that the addition of new constructs including TL and MSR, which wasn't tested in previous studies, contributed to the original model. One of the other implications of the current study is that the variance explained in the extended model of technology acceptance can be improved by adding new external constructs. The conceptual model with external constructs classified as individual and environmental explained 51% of the variance in BI. The explained variance was higher than the value obtained in previous studies (Teo, 2012). However, the unexplained variance of BI in this study was found as 49%. Thus, it is open to model development by adding new variables. Based on previous studies, the SN of the General Extended Technology Acceptance Model for E-Learning and the facilitating conditions of The Unified Theory of Acceptance and Use of Technology were examined as external factors in the extended TAM. The study showed that the effect of SN on the extended TAM was significant, but the effect of FC was not. Another conclusion from this study is that variables from different theoretical models can be included in the extended TAM. In conclusion, the extended TAM is still valid today, but can be further improved.

5.1. Limitations and future lines of research

As with many past studies, the present study has some limitations that need to be noted. First, even though the sample, which was determined using the convenience sampling approach, reflects young educators who frequently use technology in their daily life, generalizing the research results to all educators in different age groups may not give accurate results. The sampling range (i.e., in-service teachers) and age range should be greater to provide higher external validity in future studies. Second, the data were collected using self-determined scales so sample of the study may be withdrawn about reflecting their true thoughts due to the ethical and moral pressures. Therefore, this situation should be taken into account when interpreting the data. Third, as researchers used limited external factors involved in the TAM model, the results of the present study may be open for different interpretations, meanings and recommendations. In order to better interpret the study, different conceptual models with comprehensive constructs can be used in future studies. Fourth, while the study conducted the effect of some mediator variables on intentions, it didn't examine the effect of moderator variables that are likely to be important on intentions to use Web 2.0 technologies. Future studies may purpose to test the differences with regards to some variables such as sample type, gender, age, and marital statuses.

6. FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

7. REFERENCES

- Abdullah, F., & Ward, R. (2016). Developing a General Extended Technology Acceptance Model for E-Learning (GETAMEL) by analysing commonly used external factors. *Computers in human behavior*, 56, 238-256. <https://doi.org/10.1016/j.chb.2015.11.036>
- Adov, L., & Mäeots, M. (2021). What can we learn about science teachers' technology use during the COVID-19 pandemic? *Education sciences*, 11(6), 255. <https://doi.org/10.3390/educsci11060255>
- Ajjan, H., & Hartshorne, R. (2008). Investigating faculty decisions to adopt Web 2.0 technologies: Theory and empirical tests. *The internet and higher education*, 11(2), 71-80. <https://doi.org/10.1016/j.iheduc.2008.05.002>
- Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, 50(2), 179-211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Ajzen, I. (2006). *Constructing a theory of planned behavior questionnaire*. <http://people.umass.edu/~ajzen/pdf/tpb.measurement.pdf>
- Al-Dokhny, A., Drwish, A., Alyoussef, I., & Al-Abdullatif, A. (2021). Students' intentions to use distance education platforms: An investigation into expanding the technology acceptance model through social cognitive theory. *Electronics*, 10(23), 1-23. <https://doi.org/10.3390/electronics10232992>
- Alenezi, A. R. Karim, A. M. A., & Veloo, A. (2011). Institutional support and e-learning acceptance: an extension of the technology acceptance model. *International Journal of Instructional Technology and Distance Learning*, 8(2), 3-16
- Armenteros, M., Liaw, S. S., Fernández, M., Díaz, R. F., & Sánchez, R. A. (2013). Surveying FIFA instructors' behavioral intention toward the Multimedia Teaching Materials. *Computers & Education*, 61, 91-104. <https://doi.org/10.1016/j.compedu.2012.09.010>
- Ateş, H., & Garzón, J. (2022a). Drivers of teachers' intentions to use mobile applications to teach science. *Education and Information Technologies*, 27(2), 2521-2542. <https://doi.org/10.1007/s10639-021-10671-4>
- Ateş, H., & Garzón, J. (2022b). An integrated model for examining teachers' intentions to use augmented reality in science courses. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-11239-6>
- Butler, J. W. (2012). Grappling with change: Web 2.0 and teacher educators. In D. Polly, C. Mims, & K. A. Persichitte (Eds.), *Developing technology-rich teacher education programs: Key issues* (pp. 135-150). IGI Global.
- Camilleri, M. A., & Camilleri, A. C. (2022). Learning from anywhere, anytime: Utilitarian motivations and facilitating conditions for mobile learning. *Technology, Knowledge and Learning*. <https://doi.org/10.1007/s10758-022-09608-8>
- Chen, Y. C., Hwang, R. H., & Wang, C. Y. (2012). Development and evaluation of a Web 2.0 annotation system as a learning tool in an e-learning environment. *Computers & Education*, 58(4), 1094-1105. <https://doi.org/10.1016/j.compedu.2011.12.017>
- China Internet Network Information Centre (CNNIC). (2016). *The 37th statistical report on China Internet development*. <http://cnnic.com.cn/IDR/ReportDownloads/201604/P020160419390562421055.pdf>
- Dangi, M. R. M., & Saat, M. M. (2021). 21st Century Educational Technology Adoption in Accounting Education: Does Institutional Support Moderates Accounting Educators Acceptance Behaviour and Conscientiousness Trait towards Behavioural Intention? *International Journal Academic Research in Business and Social Sciences*, 11(1), 304-333. <http://dx.doi.org/10.6007/IJARBS/v11-i1/8288>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340. <https://doi.org/10.2307/249008>

- Davis, F. D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International journal of man-machine studies*, 38(3), 475-487. <https://doi.org/10.1006/imms.1993.1022>
- Delen, E., & Liew, J. (2016). The use of interactive environments to promote self-regulation in online learning: A literature review. *European Journal of Contemporary Education*, 15(1), 24-33. <https://doi.org/10.13187/ejced.2016.15.24>
- Faizi, R. (2018). Teachers' perceptions towards using Web 2.0 in language learning and teaching. *Education and Information Technologies*, 23(3), 1219-1230. <https://doi.org/10.1007/s10639-017-9661-7>
- Fussell, S. G., & Truong, D. (2021). Accepting virtual reality for dynamic learning: an extension of the technology acceptance model. *Interactive Learning Environments*. <https://doi.org/10.1080/10494820.2021.2009880>
- Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2019). *Multivariate data analysis*. Cengage Learning.
- Huang, F., Teo, T., & Guo, J. (2021). Understanding English teachers' non-volitional use of online teaching: A Chinese study. *System*, 101, 102574. <https://doi.org/10.1016/j.system.2021.102574>
- Huang, F., Teo, T., & Zhou, M. (2020). Chinese students' intentions to use the Internet-based technology for learning. *Educational Technology Research and Development*, 68(1), 575-591. <https://doi.org/10.1007/s11423-019-09695-y>
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a multidisciplinary journal*, 6(1), 1-55. <https://doi.org/10.1080/10705519909540118>
- Hursen, C. (2021). The effect of problem-based learning method supported by web 2.0 tools on academic achievement and critical thinking skills in teacher education. *Technology, Knowledge and Learning*, 26(3), 515-533. <https://doi.org/10.1007/s10758-020-09458-2>
- Jimoyiannis, A. (2010). Integrating Web 2.0 in education: Towards a framework for Pedagogy 2.0. In R. Hackney & C. Evans (Eds.), *Web 2.0 Conference Abstracts* (p. 5). Brunel University.
- Khlaisang, J., Teo, T., & Huang, F. (2021). Acceptance of a flipped smart application for learning: a study among Thai university students. *Interactive Learning Environments*, 29(5), 772-789. <https://doi.org/10.1080/10494820.2019.1612447>
- Lai, C. (2015). Modeling teachers' influence on learners' self-directed use of technology for language learning outside the classroom. *Computers & Education*, 82, 74-83. <https://doi.org/10.1016/j.compedu.2014.11.005>
- Lai, H. M., & Chen, C. P. (2011). Factors influencing secondary school teachers' adoption of teaching blogs. *Computers & Education*, 56(4), 948-960. <https://doi.org/10.1016/j.compedu.2010.11.010>
- Li, Y., Wang, Q., & Lei, J. (2019). Modeling Chinese Teachers' Attitudes Toward Using Technology for Teaching with a SEM Approach. *Computers in the Schools*, 36, 122-141. <https://doi.org/10.1080/07380569.2019.1600979>
- Liaw, S., & Huang, H. (2013). Perceived satisfaction, perceived usefulness and interactive learning environments as predictors to self-regulation in e-learning environments. *Computers & Education*, 60(1), 14-24. <https://doi.org/10.1016/j.compedu.2012.07.015>
- Lim, J., & Newby, T. J. (2020). Preservice teachers' Web 2.0 experiences and perceptions on Web 2.0 as a personal learning environment. *Journal of Computing in Higher Education*, 32(2), 234-260. <https://doi.org/10.1007/s12528-019-09227-w>
- Lim, J., & Newby, T. J. (2021). Preservice teachers' attitudes toward Web 2.0 personal learning environments (PLEs): Considering the impact of self-regulation and digital literacy. *Education and Information Technologies*, 26(4), 3699-3720. <https://doi.org/10.1007/s10639-021-10432-3>
- Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education*, 59(3), 1065-1078. <https://doi.org/10.1016/j.compedu.2012.04.016>
- Olaniran, B. A. (2009). Culture, learning styles, and Web 2.0. *Interactive Learning Environments*, 17(4), 261-271. <https://doi.org/10.1080/10494820903195124>
- Olpak, Y. Z., & Ates, H. (2018). Pre-Service science teachers' perceptions toward additional instructional strategies in biology la-

- laboratory applications: Blended learning. *Science Education International*, 29(2), 88-95. <https://doi.org/10.33828/sei.v29.i2.3>
- Padilla-Hernández, A. L., Gámiz-Sánchez, V. M., & Romero-López, M. A. (2019). Proficiency levels of teachers' digital competence: a review of recent international frameworks. *Innoeduca. International Journal of Technology and Educational Innovation*, 5(2), 140-150. <https://doi.org/10.24310/innoeduca.2019.v5i2.5600>
- Papakostas, C., Troussas, C., Krouska, A., & Sgouropoulou, C. (2022). Exploring Users' Behavioral Intention to Adopt Mobile Augmented Reality in Education through an Extended Technology Acceptance Model. *International Journal of Human-Computer Interaction*. <https://doi.org/10.1080/10447318.2022.2062551>
- Park, N., Rhoads, M., Hou, J., & Lee, K. M. (2014). Understanding the acceptance of teleconferencing systems among employees: An extension of the technology acceptance model. *Computers in Human Behavior*, 39, 118-127. <https://doi.org/10.1016/j.chb.2014.05.048>
- Pintrich, P., Smith, D., García, T., & McKeachie, W. (1991). *A manual for the use of the motivated strategies for learning questionnaire (MSLQ)*. Ann Arbor.
- Pituch, K.A., & Lee, Y. (2006). The influence of system characteristics on e-learning use. *Computers & Education*, 47, 222-244. <https://doi.org/10.1016/j.compedu.2004.10.007>
- Rahimi, E., van den Berg, J., & Veen, W. (2015). Facilitating student-driven constructing of learning environments using Web 2.0 personal learning environments. *Computers & Education*, 81, 235-246. <https://doi.org/10.1016/j.compedu.2014.10.012>
- Sadaf, A., Newby, T. J., & Ertmer, P. A. (2012a). Exploring pre-service teachers' beliefs about using Web 2.0 technologies in K-12 classroom. *Computers & Education*, 59(3), 937-945. <https://doi.org/10.1016/j.compedu.2012.04.001>
- Sadaf, A., Newby, T. J., & Ertmer, P. A. (2012b). Exploring factors that predict preservice teachers' intentions to use Web 2.0 technologies using decomposed theory of planned behavior. *Journal of Research on Technology in Education*, 45(2), 171-196. <https://doi.org/10.1080/15391523.2012.10782602>
- Sadaf, A., Newby, T. J., & Ertmer, P. A. (2016). An investigation of the factors that influence preservice teachers' intentions and integration of Web 2.0 tools. *Educational Technology Research and Development*, 64(1), 37-64. <https://doi.org/10.1007/s11423-015-9410-9>
- Shapiro, J. J., & Hughes, S. K. (1996). Information literacy as a liberal art? *Educom Review*, 31, 31-35.
- Shihab, M. (2008). *Web 2.0 tools improve teaching and collaboration in English language classes*. In Presented at the National Educational Computing Conference 2008, San Antonio, TX.
- Su, A. Y., Yang, S. J., Hwang, W. Y., & Zhang, J. (2010). A Web 2.0-based collaborative annotation system for enhancing knowledge sharing in collaborative learning environments. *Computers & Education*, 55(2), 752-766. <https://doi.org/10.1016/j.compedu.2010.03.008>
- Sungur-Gül, K., & Ateş, H. (2021). Understanding pre-service teachers' mobile learning readiness using theory of planned behavior. *Educational Technology & Society*, 24(2), 44-57.
- Taufique, K. M. R., & Vaithianathan, S. (2018). A fresh look at understanding green consumer behavior among young urban Indian consumers through the lens of theory of planned behavior. *Journal of cleaner production*, 183, 46-55. <https://doi.org/10.1016/j.jclepro.2018.02.097>
- Teo, T. (2009). The impact of subjective norm and facilitating conditions on pre-service teachers' attitude toward computer use: A structural equation modeling of an extended technology acceptance model. *Journal of Educational Computing Research*, 40(1), 89-109. <https://doi.org/10.2190/EC.40.1.d>
- Teo, T. (2010). A path analysis of pre-service teachers' attitudes to computer use: applying and extending the technology acceptance model in an educational context. *Interactive Learning Environments*, 18(1), 65-79. <https://doi.org/10.1080/10494820802231327>
- Teo, T. (2012). Modelling the Influences of Beliefs on Preservice Teachers' Attitudes towards Computer Use. *European journal of educational research*, 1, 13-22. <https://doi.org/10.12973/eu-jer.1.1.13>
- Teo, T., & Dai, H. M. (2022). The role of time in the acceptance of MOOCs among Chinese university students. *Interactive Learning Environments*, 30(4), 651-664. <https://doi.org/10.1080/10494820.2019.1674889>

- Teo, T., Sang, G., Mei, B., & Hoi, C. K. W. (2019). Investigating pre-service teachers' acceptance of Web 2.0 technologies in their future teaching: a Chinese perspective. *Interactive Learning Environments*, 27(4), 530-546. <https://doi.org/10.1080/10494820.2018.1489290>
- Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: Toward a conceptual model of utilization. *MIS quarterly*, 15(1), 125-143. <https://doi.org/10.2307/249443>
- Torras Virgili, M. E. (2021). Emergency Remote Teaching: ICT applied to education during confinement by COVID-19. *Innoeduca. International Journal of Technology and Educational Innovation*, 7(1), 122-136. <https://doi.org/10.24310/innoeduca.2021.v7i1.9079>
- Tu, C. H., Yen, C. J., & Sujo-Montes, L. E. (2015). Personal learning environments and self-regulated learning. In R. Papa (Ed.), *Media rich instruction: Connecting curriculum to all learners* (pp. 35-48). Springer.
- Vargo, D., Zhu, L., Benwell, B., & Yan, Z. (2021). Digital technology use during COVID-19 pandemic: A rapid review. *Human Behavior and Emerging Technologies*, 3(1), 13-24. <https://doi.org/10.1002/hbe2.242>
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 27(3), 425-478. <https://doi.org/10.2307/30036540>
- Wang, Y., Yu, L., & Yu, Z. (2022b). An extended CCTalk technology acceptance model in EFL education. *Education and Information Technologies*. Advance online publication. <https://doi.org/10.1007/s10639-022-10909-9>
- Wang, Y., Zhang, X., & Wang, L. (2022a). Assessing the intention to use sports bracelets among Chinese university students: an extension of technology acceptance model with sports motivation. *Frontiers in Psychology*, 13, 1-11. <https://doi.org/10.3389/fpsyg.2022.846594>
- Winne, P. H. (2011). A cognitive and metacognitive analysis of self-regulated learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 15-32). Routledge.
- Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker & J. Dunlosky (Eds.), *Metacognition in educational theory and practice* (pp. 277-304). The Educational Psychology Series. Erlbaum.
- Yen, C. J., Tu, C. H., Sujo-Montes, L. E., Armfield, S. W., & Chan, J. Y. (2013). Learner self regulation and web 2.0 tools management in personal learning environment. *International Journal of Web-Based Learning and Teaching Technologies (IJWLTT)*, 8(1), 46-65. <http://dx.doi.org/10.4018/jwltt.2013010104>
- Yu, T. K., Lin, M. L., & Liao, Y. K. (2017). Understanding factors influencing information communication technology adoption behavior: The moderators of information literacy and digital skills. *Computers in Human Behavior*, 71, 196-208. <https://doi.org/10.1016/j.chb.2017.02.005>
- Zhou, L., Xue, S., & Li, R. (2022). Extending the Technology Acceptance Model to explore students' intention to use an online education platform at a University in China. *SAGE Open*, 12(1), 1-13. <https://doi.org/10.1177/2158244022108525>
- Zimmerman, B. J. (1998). Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice* (pp. 1-19). Guilford Press.
- Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13-39). Academic press. <https://doi.org/10.1016/B978-012109890-2/50031-7>