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The Role of Personal Variables and Emotions Related to Preservice Teachers' Intention to Use Information Technologies in Acceptance of Educational Use of the Internet of Things (IoT)

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Abstract

The purpose of this study is to examine the relationship between pre-service teachers' internet of things acceptance behaviors (intention, usefulness, ease of use, facilitating conditions) and personal variables and information technology (IT) emotions. The research participants consisted of 171 pre-service teachers studying at the education faculty of a state university in Turkey. A personal information form and two different scales (IoT technologies acceptance scale and IT Emotion Scale) were used to collect data. Multiple Linear Regression Analysis was used in the analysis of the data. As a result of the research, competency in using digital technologies was an important predictor of the scores related to usability, and the increase in competency in using digital technologies positively affected the scores related to usability. The experience of using digital technologies and fun are important predictors in explaining the scores related to intention. The experience of using digital technologies and the increase in fun positively affect the scores related to intention. The experience of using digital technologies is an important predictor of the scores related to ease of use, and the increase in the experience of using digital technologies positively affects the scores related to ease of use. Finally, the scores related to the facilitating conditions of the competency in using digital technologies are an important predictor, and the increase in the competency of using digital technologies positively affects the scores of the facilitating conditions.

Key Words

Acceptance • Emotions in intention to use information technologies • Internet of things • Preservice teachers

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As technology offers new possibilities every day, the internet of things is one of these opportunities related to technology. With the integration of physical objects into information networks, internet of things technologies has emerged (Özdemir et al., 2014). According to Sarıtepeci et al. (2021), the internet of things (IoT) is a system that can transfer data between interrelated objects (sensors, devices, digital machines, mechanical tools, etc.) and people over a network. Sula et al. (2013) define the term internet of things as a global infrastructure that connects physical objects with the same internet protocol, allowing them to communicate and share information. The internet of things is an efficient technology with the aggregation and interoperability of various technologies (e.g. sensors, cloud systems, information security, etc.). This technology enables remote monitoring and control of objects, creating opportunities to communicate and integrate between physical and virtual worlds (Ray et al., 2016).

The internet of things applications are used in various fields. For example, education, health, marketing, customer service, smart homes, smart cities, and industry (Kassab et al., 2022; Sarıtepeci et al., 2021). The use of IoT technologies in the field of education can be considered relatively new compared to other field (Gökçearslan et al., 2022). Gökçearslan and Sarıtepeci (2021) draw attention to the integration of IoT technologies into more complex systems that include student participation, performance, and motivation in educational environments. Zaerov et al. (2020) emphasize the importance of adjustments such as heat, light, and air quality to provide an efficient learning environment. Gokcearslan et al. (2022) highlighted that smart classrooms' laboratory studies can be developed in the context of the internet of things, and if this technology is integrated into e-learning environments, it can enrich learning with various technologies such as augmented reality, wearable technology, and big data. According to Kassab et al. (2022), IoT applications are important in the education sector to address a wide variety of situations, goals, issues, and perceptions, monitor participation, and classroom activities, and improve knowledge on various topics.

In educational institutions that develop a vision to adapt to technological developments and change, the use of new technologies for educational purposes can provide many positive outcomes (Yildiz Durak, 2019). However, the key role in this integration belongs to teachers (Yildiz Durak, 2021a, 2021b). Stojanovic et al. (2020), on the other hand, indicated the limited number of studies on pre-service teachers' acceptance of these technologies. In this context, it is the first and most important step for the integration of this technology to raise the cognition and awareness of the teachers and, more importantly, the pre-service teachers about the importance of the use of the Internet of things.

Although there are various studies on the inclusion of the Internet of things in the field of education, there is a need for studies, especially on the variables that affect the acceptance by pre-service teachers and their intentions for their future applications. Thus, this study focuses on the acceptance and usage intentions of pre-service teachers regarding the inclusion of the Internet of things in the field of education. The current study discussed personal variables and emotions about ICT use in the context of beliefs, attitudes, intentions, perceptions, and behaviors proposed by Davis (1989) and adapted into education by Ionescu-Feleaga (2021). The technology acceptance model (TAM), which defines pre-service teachers' use of technology, provides a conceptual framework. According to TAM, the realization of the behavior of using technology is related to the behavioral intention to use it, and the intention is related to the perception of convenience, usefulness, and facilitating conditions (Davis, 1985, 1989). In

this context, pre-service teachers' perception of IoT technology as easy to use, perceived usefulness, and facilitating situations may affect their intention to use this technology in their future lessons. On the other hand, the achievement is defined as directly related to successful activities or successful results (Pekrun, 2006). Emotional processes in technology-based learning are associated with engagement, success, and satisfaction (Atman Uslu & Yildiz Durak, 2022). Identifying key emotions and examining their impact on technology acceptance is important for learning performance. According to Saadé and Kira (2006), emotion refers to feelings of sadness, boredom, happiness, pleasure, displeasure, or hatred related to a particular behavior. In this context, positive emotions towards a learning tool trigger important gains such as experience, knowledge, acceptance of use and self-efficacy. Negative emotions cause avoidance from the digital learning tool. Therefore, the emotion variable is considered as a variable in the study.

Ionescu-Feleaga et al. (2021) identified five acceptance structures for the IoT as intent, usefulness, ease of use, facilitating conditions, and training on the use of IoT technologies. Gokcearslan et al. (2022), on the other hand, validated four of these five constructs for the Turkish sample. In this study, the acceptance of the Internet of things in the educational environment was examined in the context of these four structures.

Purpose of the Study

The purpose of the current study is to examine the relationship between pre-service teachers' internet of things acceptance behaviors (intention, usefulness, ease of use, facilitating conditions) and personal variables and ICT emotions. For this purpose, answers to the following research questions are sought:

- Do pre-service teachers' personal variables and ICT emotions predict usefulness from their IoT acceptance behaviors?
- Do pre-service teachers' personal variables and ICT emotions predict intention from their IoT acceptance behavior?
- Do pre-service teachers' personal variables and ICT emotions predict ease of use from their IoT acceptance behavior?
- Do pre-service teachers' personal variables and ICT emotions predict facilitating conditions from their Internet of Things acceptance behaviors?

Method

Participants

The sample of the research consist of 171 pre-service teachers studying at the education faculty of a state university in Turkey. Pre-service teachers from many different departments participated in the study. Students are studying in 1st to 4th grade. 74.9% of the participants are female and 25.1% are male. The average age of the participants is 19.02.

Research Instruments

IoT technologies acceptance scale: Ionescu-Feleaga et al. (2021) developed this scale and this scale was translated into Turkish by Gökçearslan et al. (2022). In the 15-item scale structure, 4 factors are as follows: (a) intention (three items), (b) usefulness (five items), (c) ease of use (four items), and (d) facilitating conditions (three items). The answers in the scale are in five-point Likert type. The Cronbach's alpha value of this scale was calculated as 0.798 for intent, 0.898 for usefulness, 0.807 for ease of use, and 0.709 for facilitating conditions.

IT emotion scale: This scale was developed by Şahin (2021). There are 4 factors and 14 items on the scale. Factors in the scale are as follows: fun, enjoyment, anxiety, and frustration. The answers in the scale are in five-point Likert type. Cronbach's alpha coefficients of the scale factors were found to be fun α=0.923, enjoyment α=0.918, frustration α=0.892, and anxiety α=0.881. Therefore, the dimensions of the data collection tool have a high level of reliability.

Data Analysis

Multiple Linear Regression Analysis was used in the analysis of the data. Analyzes were made with IBM SPSS 24. From the analysis of the data, the skewness and kurtosis coefficients were examined for normal distribution. The values of kurtosis and skewness between -3 and +3 are accepted as an indication that the data has a normal distribution (Tabachnick & Fidell, 2007). Skewness values ranged between -1.46 and 0.65, and kurtosis coefficients ranged between -0.77 and 2.68. In this context, the data have a normal distribution.

The existence of autocorrelation between the variables was tested using the Durbin-Watson coefficient. The Durbin-Watson coefficient calculated between 1.5 and 2.1 indicates that there is no autocorrelation problem between the variables. VIF values considered collinearity statistics range from 1.04 to 4.81. These values demonstrate that there is no collinearity problem that is not suitable for regression analysis.

Results

The regression analysis results regarding the pre-service teachers' internet of things acceptance behaviors (intention, usefulness, ease of use, facilitating conditions), personal variables, and the predictive status of ICT emotions are presented in Table 1, Table 2, Table 3, and Table 4.

Table 1

Multiple Regression Analysis Results on Personal Variables and ICT Emotions Predicting Usefulness from the Internet of Things Acceptance Behaviors

	B	**Std. Error**	**B**	**t**	**Sig.**
(Constant)	9.811	5.255		1.867	0.064
Gender	0.471	0.667	0.052	0.706	0.481
Age	0.064	0.258	0.017	0.25	0.803

Daily usage time of digital technologies	0.027	0.108	0.018	0.252	0.801
Experience in using digital technologies (in years)	0.01	0.097	0.008	0.106	0.916
Competence in using digital technologies	0.53	0.177	0.25	2.989	0.003
Fun	0.195	0.179	0.16	1.088	0.278
Enjoyment	0.233	0.141	0.246	1.648	0.101
Anxiety	0.058	0.139	0.047	0.42	0.675
Frustration	-0.039	0.106	-0.041	-0.366	0.715

In Table 1, according to the multiple regression results between the predictor variables and the predicted variable, all the independent variables included in the model explain approximately 26% of the total variance regarding the dependent variable usefulness behaviors (R=0.506, R2=0.256, p<.01). This indicates that the 74% change in usefulness scores can be explained by different variables that were not included in the regression model. According to the standardized regression coefficients (β), the relative importance of the predictor variables on usefulness is "competence in using digital technologies, enjoyment, fun, gender, anxiety, daily usage time of digital technologies, age, experience in using digital technologies (in years), and frustration". According to the t-test results regarding the significance of the regression coefficients, competence in using digital technologies (t=2.989, p<.05), one of the predictor variables, is an important predictor in explaining the scores related to usefulness. Accordingly, considering the positive relationship, the increase in competency in using digital technologies positively affects the increase in usefulness scores.

Table 2

Multiple Regression Analysis Results on Personal Variables and ICT Emotions Predicting Intention from the Internet of Things Acceptance Behaviors

	B	**Std. Error**	**B**	**T**	**Sig.**
(Constant)	2.648	3.29		0.805	0.422
Gender	0.065	0.418	0.012	0.156	0.876
Age	0.255	0.161	0.113	1.579	0.116
Daily usage time of digital technologies	-0.008	0.068	-0.008	-0.115	0.908

Experience in using digital technologies (in years)	0.143	0.061	0.192	2.347	0.02
Competence in using digital technologies	0.118	0.111	0.091	1.062	0.29
Fun	-0.011	0.112	-0.015	-0.099	0.922
Enjoyment	0.208	0.088	0.361	2.352	0.02
Anxiety	-0.002	0.087	-0.003	-0.025	0.98
Frustration	0.016	0.066	0.029	0.249	0.804

In Table 2, according to the multiple regression results between the predictor variables and the predicted variable, all the independent variables included in the model explain approximately 21% of the total variance regarding intention behaviors, which is the dependent variable (R=0.460, R2=0.211, p<.01). This indicates that the 79% change in intention scores can be explained by different variables that were not included in the regression model.

According to the standardized regression coefficients (β), the relative order of importance of the predictor variables on the intention is "enjoyment, experience in using digital technologies (in years), age, competence in using digital technologies, frustration, gender, anxiety, daily usage time of digital technologies, and fun".

When the t-test results regarding the significance of the regression coefficients are analyzed, the predictor variables "experience in using digital technologies (in years) (t=2.347, p<.05)" and "enjoyment (t=2.352, p<.05)" scores on intention are important predictors in explaining intention scores.

Table 3

Multiple Regression Analysis Results Regarding Personal Variables and ICT Emotions Predicting Ease of Use from the Internet of Things Acceptance Behaviors

	B	**Std. Error**	**B**	**T**	**Sig.**
(Constant)	5.494	3.481		1.579	0.116
Gender	-0.225	0.442	-0.039	-0.509	0.611
Age	0.147	0.171	0.062	0.861	0.39
Daily usage time of digital technologies	0.023	0.072	0.023	0.314	0.754
Experience in using digital technologies (in years)	0.125	0.064	0.161	1.979	0.049

Competence in using digital technologies	0.079	0.118	0.059	0.673	0.502
Fun	0.156	0.118	0.201	1.313	0.191
Enjoyment	0.116	0.093	0.192	1.236	0.218
Anxiety	-0.003	0.092	-0.004	-0.036	0.972
Frustration	0.001	0.07	0.002	0.015	0.988

In Table 3, according to the multiple regression results between the predictor variables and the predicted variable, all the independent variables included in the model explain approximately 19% of the total variance regarding the dependent variable ease of use behaviors (R=0.439, R2=0.193, p<. 01). This indicates that the 81% change in ease-of-use scores can be explained by different variables that are not included in the regression model.

According to the standardized regression coefficients (β), the relative importance of the predictor variables on ease of use is "fun, enjoyment, experience in using digital technologies (in years), age, competence in using digital technologies, daily usage time of digital technologies, frustration, anxiety, and gender".

When the t-test results regarding the significance of the regression coefficients are analyzed, one of the predictor variables, experience in using digital technologies (in years) (t=1.979, p<.05) is an important predictor in explaining the scores related to ease of use. Accordingly, considering the positive relationship, the increase in the experience of using digital technologies positively affects the increase in the scores of ease of use.

Table 4

Multiple Regression Analysis Results on Personal Variables and ICT Emotions Predicting Facilitating Conditions from the Internet of Things Acceptance Behaviors

	B	**Std. Error**	**B**	**t**	**Sig.**
(Constant)	3.108	3.129		0.993	0.322
Gender	-0.017	0.397	-0.003	-0.042	0.966
Age	0.197	0.153	0.093	1.285	0.201
Daily usage time of digital technologies	0.002	0.065	0.002	0.028	0.978
Experience in using digital technologies (in years)	-0.039	0.058	-0.055	-0.673	0.502
Competence in using digital technologies	0.352	0.106	0.289	3.334	0.001
Fun	0.011	0.106	0.016	0.107	0.915
Enjoyment	0.165	0.084	0.304	1.967	0.051

Anxiety	0.082	0.083	0.115	0.997	0.32
Frustration	-0.049	0.063	-0.091	-0.777	0.438

According to the multiple regression results between the predictor variables and the predicted variable in Table 4, all the independent variables included in the model explain approximately 20% of the total variance regarding the dependent variable facilitating conditions behaviors (R=0.447, R2=0.200, p<.01). This indicates that the 80% change in facilitating conditions scores can be explained by different variables that were not included in the regression model.

According to the standardized regression coefficients (β), the relative importance of the predictor variables on facilitating conditions is "enjoyment, competence in using digital technologies, anxiety, age, fun, daily usage time of digital technologies, gender, experience in using digital technologies (in years), frustration".

When the t-test results regarding the significance of the regression coefficients are examined, competence in using digital technologies (t=3.334, p<.05), one of the predictor variables, is an important predictor in explaining the scores of facilitating conditions. Accordingly, considering the positive relationship, the increase in competency in using digital technologies positively affects the increase in the scores related to facilitating conditions.

Discussion

As a result of the research, competence in using digital technologies is an important predictor in explaining the scores related to usefulness. The increase in competency in using digital technologies positively affects the increase in the scores related to usefulness. ICT competence is not limited to technical skills and represents a broad and holistic body for building technological pedagogical knowledge with cognitive and instructional tools to promote learning (Tondeur et all., 2018). ICT competence has a key role in the integration of technology into education (Gökçearslan et al., 2022). On the other hand, Şahin (2021) emphasizes that competency can enable pre-service teachers to believe that they can use technology easily if they see themselves as competent in using digital technologies. In this context, the findings of the studies in the literature are in line with the current research findings. In the context of this result, it can be suggested that increasing the competence in using digital technologies of teacher candidates is taken as a basic starting point and the development of courses, contents and applications for this.

Experience in using digital technologies (in years) and enjoyment are important predictors in explaining the scores related to intention, and the increase in experience in using digital technologies and enjoyment positively affects the increase in intention scores. Triandis (1980) emphasizes that there is a strong relationship between emotion and behavior. Saadé and Kira (2006) emphasize that the emotion component affects an individual's emotional state towards technology, affecting all work and operations actually done or intended to do, perceived ease or difficulty. This effect points to the importance of emotion in explaining greater variability in users' intentions and behaviors. Among these emotions, especially enjoyment has a critical role in providing intrinsic motivation. Therefore, the fact that pre-service teachers see the use of digital technologies in education as a fun activity can reveal the flow experience and increase willingness (Şahin, 2021). This may strengthen the belief in the educational

benefit of technology. In this context, in future studies, the effect of the enjoyment element on the acceptance of new technologies such as the internet of things can be examined with experimental studies.

Experience in using digital technologies (in years) is an important predictor in explaining the ease-of-use scores. Ease-of-use is one of the most effective constructs affecting the intention to use technology (Venkatesh & Davis, 2000). This result shows that the ease-of-use perceptions of teacher candidates regarding integrating technology into their lessons are affected by their experiences of using digital technologies. In this context, it can be said that the implementation of applications that will expand the technology use experiences of teacher candidates will have positive reflections on their acceptance of new technologies. However, in this study, the concept of experience is taken as years. This can be considered as a limitation. In future studies, the context of the concept of experience should be examined in depth with qualitative studies.

The increase in the experience of using digital technologies positively affects the increase in ease-of-use scores. In this context, improving technology use experiences of pre-service teachers will positively affect their intentions and perceptions about using new technologies. Al-Abdullatif et al. (2022) highlighted that perceived ease of use and usefulness positively affect pre-service teachers' attitudes toward the use of IoT in classrooms.

Finally, competency in using digital technologies is an important predictor in explaining scores on facilitating conditions and increasing competency in using digital technologies positively affects scores on facilitating conditions. Gokcearslan et al. (2022) found that ICT competency is associated with usefulness, ease of use, and facilitating conditions. These study findings support the findings of this study. In this context, improving technology use experiences and competencies of pre-service teachers will positively affect their intentions and perceptions about using new technologies.

Ethic

In this study, all scientific ethical rules were followed.

Author Contributions

All stages of the study were organized and conducted by the authors.

Conflict of Interest

In addition, the authors declare that they have no conflict of interest.

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