Factors Affecting the Adoption of e-Learning at University Level

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Abstract: The dynamic development of e-learning technologies caused by the global epidemiological situation during the last year has prompted the rapid adaptation of the education sector to new challenges. At the same time, many barriers and challenges have emerged, especially at the initial period of e-learning implementation. The identification of factors determining the adoption of e-learning should be the source of information needed to improve the methods and tools used by educational institutions. In the era of strong competition, higher education institutions need to improve their business models or build new ones e.g. based on remote learning. The article aims to identify the essential success factors and their interlinks that explain the initial stages of adoption of an e-learning system by university students in Poland. The author built three regression models which explain relationships between six input variables, i.e., the perceived usefulness (PU), the perceived ease of use (PEU), facilitating conditions (FC), computer self-efficacy (CSE), the preparedness level (PL), and previous experience (PE); and three output variables, i.e., satisfaction and personal development (SPD), attitude toward e-learning (AT), and intention to use (IU). The variable "satisfaction and personal development" (SPD) was newly added to the model. Data was collected with the help of a survey, which was conducted using the CAWI (computer-assisted web interview) technique. In total, 982 completed questionnaires were received. Results achieved using a regression analysis confirmed that the perceived usefulness played a crucial role in building the attitude of students toward e-learning and achieving satisfaction and personal development of the users. Only in the case of two analyzed variables, the obtained results confirmed statistically significant differentiation within the two gender groups. Results confirmed that men had declared a high level of computer self-efficacy. The variable "facilitating conditions" received higher marks from women. The research carried out and the results obtained may form the basis for building strategies for the development of universities and building business models in which e-learning plays an important role.

Key-Words: e-learning, technology acceptance model, intention to use, attitude toward e-learning

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1 Introduction

The worldwide epidemiological situation caused by the COVID-19 virus has forced society to rapidly adapt to different forms of remote communication and learning. Many face-to-face processes had to be replaced with solutions based on ICT technologies. Education is one of the areas that had to face the challenge [1], [2]. At different levels of education (primary, secondary, tertiary as well as life-long learning), both parties to the process — teachers and students — were forced to turn to e-learning. E-learning is the process of acquiring knowledge using information and communication technologies and resources. It is expected that in the perspective of 2026, the global e-learning market will increase from USD 200 billion in 2019 to USD 375 billion [3].

The successful implementation of e-learning solutions depends on many factors, the recognition of which should lay the foundation for developing appropriate strategies of action aimed at users as well as the improvement of technological solutions [4], [5]. Especially in a period requiring rapid and unexpected adaptation to changes (e.g., epidemiological situation), such analysis seems to be critical and relevant.

E-learning technologies must be accepted by their users [6], [7]. Just because a technology is widely available does not mean that it will be used extensively and effectively [8], [9], [10], [11], [12]. Many authors used theoretical models to measure the level of acceptance of e-learning technologies. Among the most well-known models, the most prominent are the Technology Acceptance Model (TAM, TAM2, TAM3), the Unified Theory of Acceptance and the Use of Technology (UTAUT) and DeLone and McLean Information Systems (D&M IS). Although e-learning methods are successfully used in business as a method of training, e-learning remains a challenge for teachers

and students in any formal (traditional) education. Although in Poland, the market of e-learning services is developing extremely fast, users face numerous social and technological challenges. This article aims to identify the most critical success factors that can explain the adoption of an e-learning system by university students in Poland. The obtained results can be used to build a strategy of actions at the level of an organization and the entire higher education system (HES).

The article is structured as follows. The next part presents the results of a literature review indicating commonly used constructs in technology acceptance models for e-learning technology. The following part of the article contains a description of the research methodology. The section preceding the conclusions presents the research results and discusses them in the context of outcomes by other researchers.

2 Literature Review

So far, many researchers have selected the acceptance of e-learning tools as their area of scientific research.

Most of the researchers chose the TAM model developed by Davis [13] as the starting point for their analysis. In the original version of the Technology Acceptance Model (TAM), Davis indicated that the motivation of technology users depended on the perceived usability and ease of use, i.e., the factors that determine the attitudes of users. The originally developed model of technology acceptance, known as TAM, has been modified to TAM2 [14] and TAM3 [15]. It was also the starting point for developing new technology acceptance models named UTAUT or D&M IS. Differences between the main variables in the indicated models are shown in Table 1.

Table 1. Comparison of elements comprising TAM, the UTAUT model, and the D&M IS Success model

TAM, TAM2, TAM3	UTAUT	D&M IS Success
Perceived Usefulness	Performance Expectancy	System Quality
Ease of Use	Effort Expectancy	Use
Subjective Norm	Social Influence	Service Quality
Perception of External Control) Perceived Behavioral Control	Facilitating Conditions	Information Quality
Behavioral intention	Behavioral intention	Intention to Use

Source: based on [16], [17].

According to the literature study conducted by Šumak, HeričKo, and PušNik [18], TAM is the most popular theory adopted in e-learning acceptance research.

Considering that e-learning is an IT system that integrates human and technological factors, any acceptance model of e-learning must consider its complexity.

The literature review on e-learning acceptance models has confirmed that most researchers consider the four main constructs of the TAM (perceived usefulness, perceived ease of use, attitude, and system usage) in their models. Depending on the purpose of the research, individual authors considered additional variables in the output model, which reflect the following areas:

- user attributes — experience, computer anxiety, self-efficacy, habit, personal innovativeness, openness, and enjoyment;
- support conditions — technical system quality, facilitating conditions, and technical system quality;
- quality — content and information quality, subject (academic course and practical course), course design, and service quality;
- results — satisfaction level, learning performance, and learning satisfaction;
- social influence — reputation, social recognition, and social norms.

The results of the conducted literature studies aimed at the identification of the constructs in the e-learning technology acceptance models are presented in Table 2. The obtained results allowed for the selection of variables for the research described in this article.

The following variables, which were indicated during the literature review, were divided into two categories and adopted in this research:

a) input variables:
- perceived usefulness (PU),
- perceived ease of use (PEU),
- facilitating conditions (FC),
- computer self-efficacy (CSE),
- preparedness level (PL),
- previous experience (PE),

b) input variables:
- satisfaction and personal development (SPD),
- attitude toward e-learning (AT),
- intention to use (IU).

Fig. 1 presents the theoretical model that reflects the links between all the variables.

Table 2. Constructs within technology acceptance models of e-learning

Source	E-learning tools	Research sample	Country	Constructs
[19]	Moodle	226 university students	Spain	Technical support, perceived self-efficacy, perceived usefulness, perceived ease of use, attitude, and system usage.
[20]	E-learning English course	510 students from Vocational Higher School	Turkey	Achievements, anxiety, perceived usefulness, perceived ease of use, attitude, subjective norms, perceived behavior control, satisfaction, continued intention, self-efficacy, and facilitative conditions.
[21]	Moodle	235 students	Slovenia	Perceived usefulness, perceived ease of use, attitude toward using technology, and behavioral intention.
[22]	Electronic learning systems and virtual learning environments	66 university students	Spain	Perceived usefulness, perceived ease of use, behavioral intention to use, subjective norm, self-efficacy, computer anxiety, relevance for learning, facilitating conditions, perceived interaction, perceived playfulness, habit, and personal innovativeness.
[23]	Moodle LMS	228 university students	Slovenia	Effort expectancy, performance expectancy, facilitating conditions, social influence, behavioral intention, and students' previous education.
[24]	E-learning	390 university students	Tehran	Educational quality, user satisfaction, service quality, intention to use, technical system quality, content and information quality, perceived ease of use, perceived usefulness, and actual use.
[25]	M-learning	239 university students	Jordan	Perceived self-efficacy, facilitating conditions, perceived ease of use, perceived usefulness, perceived quality of service, and behavioral intention of using.
[26]	E-portfolios	242 undergraduate students	UK	Perceived ease of use, perceived usefulness, experience, enjoyment, self-efficacy, computer anxiety, subjective norm, and behavioral intention to use.
[27]	Blackboard e-learning systems	95 undergraduate students	Malaysia	Instructor characteristics, computer self-efficacy, course design, perceived usefulness, perceived ease of use, and intention to use.
[28]	Blended e-learning system (BELS) Moodle	210 undergraduate students	Iraq	E-learning self-efficacy, perceived satisfaction, learning styles, perceived ease of use, perceived usefulness, and intention to use.
[29]	Massive Open Online Courses (MOOCs)	252 participants	China	Individual-technology fit, task-technology fit, openness, reputation, social recognition, social influence, perceived usefulness, perceived ease of use, attitude towards using, and intention to continue using.
[30]	e-learning	132 college students	Canada	Perceived usefulness, perceived ease of use, attitude, behavioral intention, computer anxiety, enjoyment, experience, self-efficacy, and subjective norm.

[31]	M-Learning courses	437 high school students	Taiwan	Subject (academic course and practical course), perceived usefulness, perceived ease of use, attitude, behavioral intention, and self-learning effectiveness.
[32]	WIKI for group work	174 university students	Hong Kong	Self-esteem, subjective norms, perceived behavioral control, perceived usefulness, perceived ease of use, attitude towards using, and intention to use behavior.
[33]	Edmodo-based e-learning	160 upper secondary students	China	Perceived usefulness, perceived ease of use, attitude towards using, behavioral intention to use, and actual usage.
[34]	e-learning	226 university students	Malaysia	Perceived usefulness, perceived ease of use, intention to use, learning performance, and learning satisfaction.
[35]	e-learning	435 university students	United Arab of Emirates	Computer self-efficacy, subjective/ social norm, enjoyment, system quality, information quality, content quality, accessibility, computer playfulness, perceived usefulness, perceived ease of use, attitude towards using, behavioral intention to use, and actual system use.
[36]	Moodle and Blackboard	282 university students	Turkey	Social norms, user interface design, computer self-efficacy, perceived usefulness, perceived ease of use, attitude towards using, behavioral intention to use, and actual use.

Source: elaborated by the author.

First of all, the author analyzed whether variables treated as input variables have a significant impact on the two variables satisfaction and personal development (SPD) and attitude toward e-learning (AT). Next, the author was interested in the influence of two satisfaction and personal development (SPD) and attitude toward e-learning (AT) variables on users' intention to use e-learning in the future.

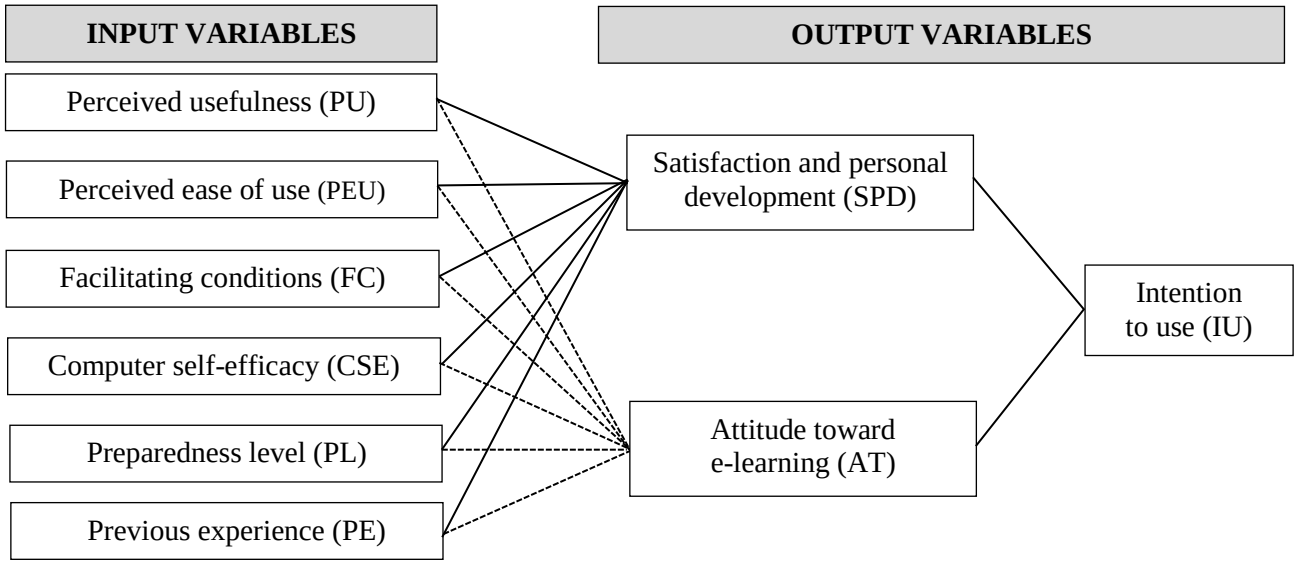

Fig. 1. Theoretical model
Source: elaborated by the author.

3 Research Method

2.1 Data

Data was collected with the help of a survey, which was conducted using the CAWI (*Computer Assisted Web Interview*) technique. A link to electronic questionnaires was distributed to individual students of Bialystok University of Technology (Poland) via the university e-mail system. Questionnaires were sent to 6080 students. They were distributed between May and September of 2020. In total, 982 completed questionnaires were received, which resulted in the high return rate of 16.2%. 463 (47.1%) of respondents were women, and 519 (52.9%) were men.

3.2 Measures

Based on the literature review, to measure six input and three output variables, 47 items were initially considered. Then, the Confirmatory Factor Analysis (CFA) was conducted to test how well the measured variables represented the number of constructs. Eventually, 32 items were used for further analysis. The constructs were measured using a seven-point Likert scale (from 1 = totally disagree to 7 = totally agree). Cronbach's alpha coefficients of the constructs were used to verify the reliability of the scale and proved the acceptable reliability of the scale ranging from 0.673 to 0.955 (Table 3). Descriptive statistics, composite reliability for the constructs, and items are presented in Table 3.

Mean values of the indicated input and output variables are shown in Figs. 2 and 3.

Using the 7-point Likert scale for the assessment of variables, the highest average score was assigned to "computer self-efficacy" (5.61) and "perceived ease of use" (4.94). The lowest rated variables were "perceived usefulness" (3.30) and "previous experience" (3.32). Students participating in the study did not have much previous experience with e-learning, which allowed to assess the adoption of this technology at its initial period of use.

Respondents assigned rather average ratings to output variables (Fig. 3). The variable "attitude toward e-learning" received a relatively high rating, which reflects the attitude of users to e-learning. However, considering the 7-point Likert scale, the average rating of 3.84 given to the "user attitude to e-learning" hardly seems particularly positive. Students gave rather low marks to the statements indicating that the development of e-learning was the right direction to improve the quality of HES services (the mean of 3.87) and the statement that e-learning was an attractive form of learning (3.81).

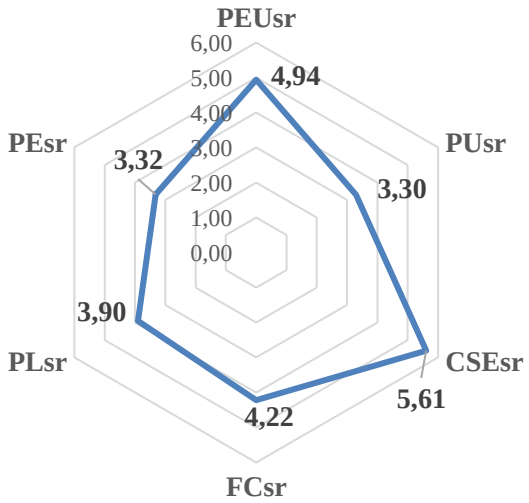

Fig. 2. Mean value of assessments — the input variables

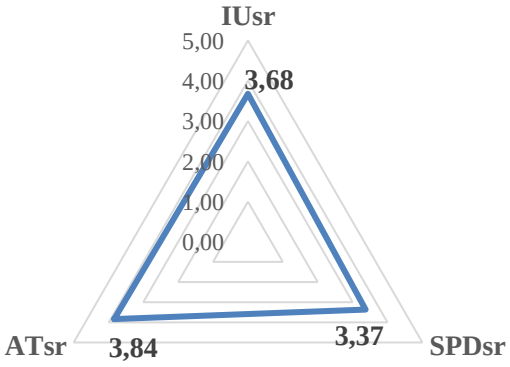

Fig. 3. Mean value of assessments — the output variables

The low assessment of student attitudes toward e-learning was caused by student unpreparedness to online education and the lack of previous positive experiences in this area. Also, many students regarded direct contact with other students and teachers as well as social relationships as the most important factor determining the overall opinion of university education.

Table 3. Constructs and items

Constructs	Ident.	Items	Mean	Cronbach's Alpha
Perceived ease of use (PEU)	PEU1	I have easily obtained the ability to use e-learning tools.	5.44	0.917
	PEU2	Using the e-learning was easy the first time.	4.61	
	PEU3	Using e-learning tools is easy and intuitive.	4.87	
	PEU4	Procedures and instructions for users explaining how to use e-learning tools are clear and understandable.	4.83	
Perceived usefulness (PU)	PU1	E-learning classes save my time.	4.02	0.955
	PU2	E-learning classes can be carried out flexibly (at different hours, days of the week).	2.98	
	PU3	E-learning classes allow me to achieve the learning effects faster.	3.02	
	PU4	By using e-learning tools, I will gain new competences.	3.38	
	PU5	E-learning tools enable me to learn more effectively and efficiently.	3.00	
	PU6	E-learning tools enable me to have more control over my learning process.	3.41	
	PU7	In general, I believe that the implementation of e-learning classes is beneficial to the education system.	3.55	
	PU8	The use of e-learning techniques ensures that I get better learning results/effects.	3.03	
Facilitating conditions (FC)	FC1	During the e-learning process, I can rely on technical support from the University.	4.03	0.833
	FC2	In the case of any suggestions concerning the functioning of e-learning tools, I can count on feedback.	4.55	
	FC3	The University provides professional assistance to users of e-learning tools through clear and understandable user instructions and guides available on the website.	4.07	
Computer self-efficacy (CSE)	CSE1	I can sort out any problems arising during the use of e-learning tools by myself.	5.29	0.927
	CSE2	I can use e-learning tools without the support of the third parties.	5.82	
	CSE3	I can use e-learning tools even if I do not have a user guide.	5.64	
	CSE4	I can use e-learning tools even if I have not used them before.	5.70	
	CSE5	I have sufficient technical resources to use e-learning tools.	5.60	
The preparedness level (PL)	PL1	Teachers have appropriate skills and competences to use e-learning tools.	3.95	0.878
	PL2	Teachers are eager to implement the curriculum using e-learning tools.	3.93	
	PL3	Teaching materials prepared by lecturers for e-learning are comprehensive, clear, and understandable.	3.83	
Previous experience (PE)	PE1	I have extensive experience with e-learning tools.	3.74	0.673
	PE2	I have already used e-learning before.	2.90	
Attitude toward e-learning (AT)	AT1	Development of e-learning is the right direction to improve the quality of HES services.	3.87	0.941
	AT2	E-learning is an attractive form of learning.	3.81	
Satisfaction and personal development (SPD)	SPD1	I enjoy using e-learning tools.	3.72	0.942
	SPD2	The use of e-learning tools is more satisfying than traditional forms of learning.	3.14	
	SPD3	The use of e-learning tools makes me more creative.	3.32	
	SPD4	E-learning gives me confidence.	3.23	
	SPD5	The use of e-learning tools gives me the feeling that I am competent and able to perform important activities.	3.45	
The intention to use (IU)	IU1	I intend to use e-learning to a greater extent.	3.74	0.933
	IU2	I intend to encourage others to use e-learning.	3.44	
	IU3	Thanks to e-learning, I am more open to new technological solutions.	3.84	

Source: elaborated by the author.

4 Results and Discussion

Three regression models were built to explain the existing relationships between variables.

Model 1: Dependent variable: satisfaction and personal development. Predictors: perceived usefulness, perceived ease of use, facilitating conditions, computer self-efficacy, preparedness level, and previous experience.

Model 2: Dependent variable: attitude toward e-learning. Predictors: perceived usefulness, perceived ease of use, facilitating conditions, computer self-efficacy, preparedness level, and previous experience.

Model 3: Dependent variable: intention to use. Predictors: satisfaction and personal development, and attitude toward e-learning.

The constructed regression models turned out to be statistically significant (Model 1: $F=500.241$, $p<0.001$; Model 2: $F=303.92$, $p<0.001$; Model 3: $F=1538.740$, $p<0.001$) and all predictive factors explained more than 65% of the dependent variables (Model 1: $R2=0.75$; Model 2: $R2=0.65$; Model 3: $R2=0.76$).

Perceived usefulness ($\beta=0.798$; $t=39.07$; $p<0.001$) and previous experience ($\beta=0.078$; $t=4.57$; $p<0.001$) had a significant positive impact on satisfaction and personal development of students.

Perceived usefulness ($\beta=0.763$; $t=31.35$; $p<0.001$), computer self-efficacy ($\beta=0.112$; $t=4.12$; $p<0.001$), and previous experience ($\beta=0.089$; $t=4.35$; $p<0.001$) had a significant positive impact on attitude toward e-learning.

Satisfaction and personal development ($\beta=0.525$; $t=17.58$; $p<0.001$) and attitude toward e-learning ($\beta=0.379$; $t=12.69$; $p<0.001$) had a significant positive impact on intention to use e-learning methods in the future.

The research results confirmed that the attitude toward e-learning and satisfaction and personal development had a strong and positive influence on the intention to use e-learning in the future.

The obtained results were consistent with conclusions reached by other authors. Wu and Chen confirmed that attitude was critical to the continuance of the intention to use MOOCs [29]. This type of relationship was also confirmed by other researchers [30], [35]. In this research, student attitude to e-learning was not particularly positive, as confirmed by the rating of the variable amounting to 3.84 on the 7-point Likert scale. Such attitudes are characteristic to early stages of new technology adoption, where their users are unprepared and often surprised by the need to use them.

Considering the achieved results, satisfaction, and personal development also had a positive impact on the intention to use e-learning tools. The findings were mostly consistent with the previous research [24], [39].

If e-learning makes students satisfied, increases their creativity, and makes them more competent and confident, it is more likely that they would use e-learning to a greater extent in the future.

An important element of the research was the identification of antecedents of attitude to e-learning as well as student satisfaction and personal development resulting from e-learning adoption.

Among all input variables, only three of them — the perceived usefulness, the computer self-efficacy and the previous experience — had a significant positive impact on the attitude toward e-learning. According to other researchers, perceived usefulness variable had a significant positive impact on an attitude toward using e-learning and was the strongest and the most important predictor of attitudes toward using e-learning tools [21], [33], [34], [37], [38]. The obtained results also confirmed this relationship indicating a strong interaction between the perceived usefulness and the attitude toward using e-learning (the highest $\beta=0.763$).

Within the theoretical model, the variable "student satisfaction and personal development" was treated as an output variable. Two variables — perceived usefulness and previous experience — had a significant positive impact on satisfaction and personal development of students; but in the case of perceived usefulness, this impact was stronger. The variable "satisfaction and personal development" was also used by other researchers but as separate variables "enjoyment", "satisfaction" or "playfulness". Mohammadi identified the perceived usefulness as a key predictor of user satisfaction toward the use of e-learning [39]. Based on TAM, Al-Azawei et al. integrated the perceived satisfaction and technology acceptance into one model and confirmed that perceived usefulness had a significant positive impact on perceived satisfaction [28]. The author proposed to extend the meaning of this variable by adding items that reflect a student's personal development. The obtained results confirmed that the perceived usefulness had a positive impact on the fact that the use of e-learning tools made students more creative and gave them the feeling that they were competent and able to perform important activities.

Table 4. Results of multiple regression analysis — Model 1

Model	Unstandardized coefficients		Standardized coefficients	t	Sig. p-value
	B	Std. Error	Beta		
Constant	-0.358	0.126		-2.851	0.004
perceived usefulness	0.843	0.022	0.798	39.068	0.000
perceived ease of use	0.056	0.028	0.048	1.996	0.046
facilitating conditions	0.046	0.026	0.039	1.747	0.081
computer self-efficacy	0.051	0.029	0.040	1.759	0.079
preparedness level	-0.022	0.027	-0.019	-0.818	0.413
previous experience	0.084	0.018	0.078	4.567	0.000

Model summary:

R	Adjusted R^2	Std. Error	df1	df2	Mean square	F	Sig.
0.869	0.753	0.939	6	975	440.829	500.241	0.000

Dependent variable: satisfaction and personal development
Source: elaborated by the author.

Table 4. Results of multiple regression analysis — Model 2

Model	Unstandardized coefficients		Standardized coefficients	t	Sig. p-value
	B	Std. Error	Beta		
Constant	-0.091	0.172		-0.531	0.595
perceived usefulness	0.925	0.029	0.763	31.350	0.000
perceived ease of use	0.019	0.038	0.014	0.503	0.615
facilitating conditions	-0.076	0.036	-0.056	-2.099	0.036
computer self-efficacy	0.163	0.040	0.112	4.117	0.000
preparedness level	-0.044	0.036	-0.034	-1.214	0.225
previous experience	0.109	0.025	0.089	4.354	0.000

Model summary:

R	Adjusted R^2	Std. Error	df1	df2	Mean square	F	Sig.
0.807	0.649	1.283	6	975	500.513	303.922	0.000

Dependent variable: attitude toward e-learning
Source: elaborated by the author.

Table 4. Results of multiple regression analysis — Model 3

Model	Unstandardized coefficients		Standardized coefficients	t	Sig. p-value
	B	Std. Error	Beta		
Constant	0.510	0.065		7.857	0.000
satisfaction and personal development	0.547	0.031	0.525	17.576	0.000
attitude toward e-learning	0.344	0.027	0.379	12.687	0.000

Model summary:

R	Adjusted R^2	Std. Error	df1	df2	Mean square	F	Sig.
0.871	0.758	0.968	2	979	1441.039	1538.740	0.000

Dependent variable: intention to use
Source: elaborated by the author.

The Mann-Whitney U test was used to verify whether there were any statistically significant relationships between the analyzed variable in two gender groups. Based on the results of the analysis, significant differences were found in the level of computer self-efficacy ($Z= -2.516$; $p<0.05$) and facilitating conditions ($Z= -3.656$; $p<0.005$). Men declared a high level of computer self-efficacy (Average Range for men = 512.86, for women = 467.55). Women gave higher marks for the variable "facilitating conditions" (Average Range for men = 460.31, for women = 526.47). Women who declared a lower level of computer self-efficacy were more satisfied with the support offered by the university when using e-learning tools (facilitating conditions). The obtained results can be used to improve the university technical support system for e-learning users, which should meet the needs and expectations of users who are growing more professional.

5 Conclusion

The obtained results confirmed that perceived usefulness plays a crucial role in shaping student attitudes toward e-learning and achieving satisfaction and personal development of the users. By evaluating the individual statements (items) within the perceived usefulness construct, the students indicated the importance of e-learning classes in saving their time and e-learning tools enabling them to have greater control over their learning process.

The research results confirmed that the attitude toward e-learning and satisfaction and personal development had a strong and positive influence on the intention to use e-learning in the future.

Based on the achieved results reflecting the factors that determine the e-learning acceptance level, higher school institutions should build long-term strategies for the improvement of the quality of e-learning. Strategic activities should focus on promoting practical e-learning functionalities related to timesaving, the flexibility of the learning process, and the possibility to develop student IT competences.

As far as the contribution to the methodology is concerned, the author elaborated the scale to measure newly added constructs named satisfaction and personal development of students.

The research findings suggest several directions for future efforts. Since there are two parties to the e-learning process, i.e., teachers and students, it is desirable to research the acceptance of the new solutions by teachers and the factors determining the effectiveness of the e-learning process from their perspective. The dynamic development of e-learning tools and methods indicates that future research should attempt to evaluate the effectiveness of such a form of learning in the context of the learning outcomes achieved by the students.

The limitations of the conducted research are related to the fact that it was carried out at an early stage of e-learning, after only three months from the beginning of online classes. The conducted research and achieved results will be the starting point for the author to further comparative analyses of changes in the level of e-learning adoption, conducted after a longer period of their application. On the other hand, the realization of research at an early stage of e-learning adoption allows eliminating the barriers in the long-term perspective and creating conditions for further effective use of new technologies.

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