University of Hormozgan

Iranian Journal of Educational Research

Print ISSN: 1735 - 563X Online ISSN: 2980 - 874X

Homepage: http://ijer.hormozgan.ac.ir

Educational and Behavioral Research Center

The Path Analysis Model of Effective Factors to E-Learning Flow among Primary School Students

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Article Info

Article type:

Research Article

Article history:

Received 30 Apr. 2025

Received in revised form 21 Jun. 2025

Accepted 24 Aug. 2025

Published online 01 Sep. 2025

Keywords:

E-learning flow,

Motivation,

Computer self-efficacy,

Perceived ease of use,

Teaching presence,

Cognitive presence,

Social presence

ABSTRACT

Objective: This study aimed to develop and test a path analysis model of effective factors contributing to e-learning flow. Specifically, it examined the roles of teaching presence, social presence, cognitive presence, perceived ease of use, computer self-efficacy, and motivation.

Methods: The statistical population included elementary school students in grades four to six. Using cluster sampling, 293 students were selected. Electronic lesson content was presented in class, followed by the administration of questionnaires related to the research variables. Data were analyzed using Pearson correlation coefficients and path analysis.

Results: Findings indicated that teaching presence had a direct and positive effect on social presence, cognitive presence, motivation, computer self-efficacy, and e-learning flow. Social presence directly and positively influenced perceived ease of use, motivation, and computer self-efficacy. Cognitive presence showed direct positive effects on motivation and e-learning flow. Motivation positively affected computer self-efficacy and e-learning flow. Finally, computer self-efficacy directly and positively influenced e-learning flow.

Conclusions: The results highlight the significant role of teaching, social, and cognitive presences, along with motivation and computer self-efficacy, in enhancing e-learning flow among elementary students. Future research is recommended to explore additional variables influencing e-learning flow across different age groups.

Cite this article: Fathi, R., Seif, M. H., Darvishi, M. & Liaghat, M. (2025). The path analysis model of effective factors to e-learning flow among primary school students. *Iranian Journal of Educational Research*, 4 (3), 1-14.

. DOI: https://doi.org/10.22034/2020.ijer.4.3.1

Publisher: University of Hormozgan.

DOI: https://doi.org/10.22034/2025.ijer.4.3.1

Introduction

In countries where the issue of new teaching methods is an important issue, due to the advances of the present era in the field of basic electronic technologies, the approach of e-learning has also played a significant role in creative and new educational methods. However, with the introduction of this method of teaching in schools, many issues and concerns have arisen for those in charge of education and parents of students. One of these issues is the educational content that is provided to the student. This content is unveiled with different faces. Sometimes in the form of animation, clips, and movies, and sometimes in the form of electronic content or games. And at a higher level, they sometimes step into the world of virtual reality, augmented reality, and mixed reality in the form of simulators. Due to the rapid growth of this type of technology, we see a big difference between the issues facing education (on the way from traditional education to modern teaching methods) in the generations of society. Sometimes the methods and equipment in the service of this science change in less than an academic year, and this makes it more difficult for experts and designers to recognize and familiarize themselves with educational programs in the face of the factors and variables of these phenomena.

Learning flow or according to the subject of this research, it is better to say that e-learning flow is one of the most important factors that can be targeted and determine the country's e-learning planning strategies.

Learning flow theorist says: learning flow is a state of deep engagement in learning activities that engages and concentrates students (Csikszentmihaly,1990).

Another point that can be seen in the process of e-learning among students is his view of his classmates' choices. This view can be independent of why a classmate chooses. Paying attention to the age group of students determines how we know and view these types of behaviors. And let's not forget that in general, we can't know how someone else is feeling, while we know what he's doing (Csikszentmihaly,1990). E-learning environments can be defined individually and in groups, and group education can be real and with the physical presence of students or with their virtual presence. Therefore, paying attention to these cases can make the teacher more aware of the reasons for students' choices.

Another idea among students is that computers can help them in all areas, and in fact, given the hardware and software features available at this point in time, such as the process of using personal

devices. Like smartphones and tablets, this idea has become a mental belief. To the extent that it has created the expectation of achieving some goals without effort. The tasks that were recently performed through the organizational use of related programs, software, and hardware have now been transferred to personal mobile devices (Filkins, 2014). As far as health care is concerned, mobile technologies are being used to monitor patients with diseases such as diabetes, kidney failure, chronic lung obstruction, and clogged arteries (Kirsch et al, 2007). These factors create a variable called perceived ease of use that can play a role in a student's mental path when using electronic content.

Another difference between students is their level of belief in their ability to work with computers. Lack of this may lead to fewer people doing less work and preventing them from improving their academic performance, while other studies show that people who have a strong sense of self-efficacy in a particular area may spend more time working and solve more challenges (Chen, 2017). Based on this, considering the factor as computer self-efficacy among students can be effective in the e-learning process.

Another point is that there are differences in the orientation and goal setting of students in each learning process, including e-learning. In this regard, one of the pivotal elements that has been studied by many researchers in learning outcomes is motivation. There are three groups of students in this field: students with internal motivation, external motivation, and students who have a sense of refusal. Students with intrinsic motivation seek innovation and challenges, expand and focus their abilities, discover and learn, and students who need to be guided by a coach or learning environment to move in a direction fall into the category of external motivation. However, the concept of refusal is completely different from the internal and external motives, and that is the complete absence of internal and external motives (Fernandez et al 2016). Therefore, recognizing and distinguishing the type and level of motivation of students can also affect their e-learning path. Accordingly, this study aimes to provide a path analysis model for the factors affecting e-learning flow among elementary students (fourth, fifth, and sixth grades).

Based on the above, this study intends to examine the variables of teaching presence, social presence, cognitive presence, perceived ease of use, computer self-efficacy and motivation as factors influencing e-learning flow in the form of conceptual models (Figure 1).

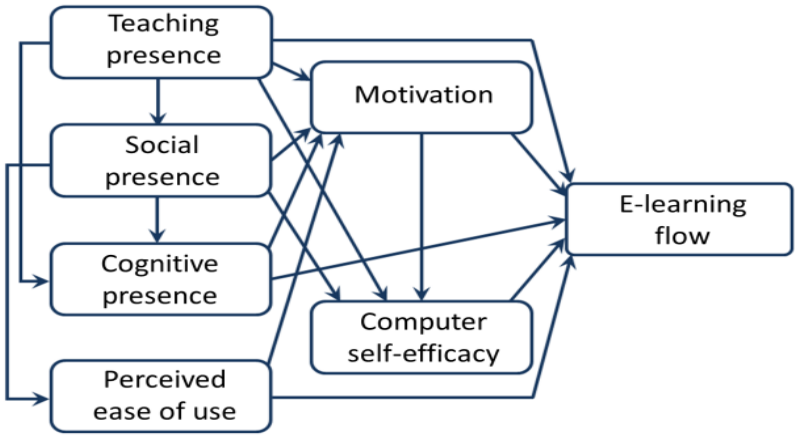

Figure 1. Conceptual model of factors affecting e-learning flow

Material and Methods

The present study examines factors influence e-learning flow among elementary school students (fourth, fifth and sixth grades), which have an objective and practical nature, and the results are tangible and clear. In this research, there is no theorizing, but it is tried to use the theories obtained from the research of others to examine the factors affecting the e-learning flow in the real situation and finally to make decisions, policies, and plans. The future of education will help in the field of e-learning for students. Based on these explanations, it can be said that the present study is based on a practical purpose. Based on nature and method, this research can be placed in the descriptive research group of correlation type and the relationships between the variables in the form of the comparative causal model are examined.

Due to the large number of the statistical population consisting of all students studying in primary school (fourth, fifth, sixth and sixth grades) as well as the nature of this research, which requires the implementation of e-learning in the classroom, to collect data and do the research sought to select a statistical sample by cluster sampling method from the target population. The number of elementary school students in these grades was selected with a sample size of 102 fourth graders, 105 fifth graders, and 103 sixth graders, for a total of 310 students. Finally, 293 questionnaires were available to the researcher. However, the sample size was 266 people using Cochran's formula, for which p and q were 0.5 and d, which is the sampling error coefficient of 0.66 .

In this research, two software "SPSS" and "LISREL" software have been used for data analysis. Data analysis was performed in descriptive and inferential sections. In descriptive analysis, mean, standard deviation, skewness and kurtosis have been used for the desired variables, and according to the obtained values of skewness and kurtosis for the research variables, the distribution of all variables is normal. Therefore, we can use the path analysis model to analyze the research findings. Accordingly, in the inferential part of the path analysis and Pearson correlation coefficient to examine the relationships between research variables and test the hypotheses in the form of a causal-comparative model based on background theoretical and experimental research was conducted.

Three electronic contents related to math lessons for the fourth, fifth, and sixth grades of elementary school has been designed and built by the researcher using Adobe Animate software (Figure 2). In this study, after presenting electronic content to students, 7 questionnaires were used to evaluate and measure 7 variables of cognitive presence, social presence, teaching presence, ease of perceived use, motivation, computer self-efficacy, and e-learning flow. The type of questions is closed. These questionnaires are adapted from 7 questionnaires (Fu et al., 2009), (Pintrich et al., 1993), (Davis et al., 1989), (Wolters and Daugherty, 2007) and (Keller, 2010). It is worth noting that the variables of cognitive presence, social presence, and educational presence of all three were measured with a questionnaire (Pintrich et al., 1993).

Figure 2. The electronic content of fourth, fifth and sixth grades (Designed and built by the researcher)

Results

First, the characteristics of descriptive statistics related to the research variables and then the correlation matrix of the variables, path coefficients, goodness of fit test characteristics, and the path fit test diagram model are presented. Table 1 lists the descriptive statistics for the sample, including mean, standard deviation, skewness, and kurtosis for the variables.

Table 1. Descriptive statistics of the research variables

Variables	Skewness	Kurtosis
e-learning flow	0.89	1.15
Motivation	1.21	1.02
Computer self-efficacy	1.34	0.78
Perceived ease of use	-1.17	1.22
Social presence	-0.93	0.45
Cognitive presence	1.00	-1.26
Teaching presence	1.61	-0.83

As it can be seen in Table 1, the distribution of all variables is normal, given the values obtained for skewness and kurtosis for research variables that are approximately between 2 and 2+, so it is possible to analyze the research findings from the path analysis model. Since the basis of path analysis studies is correlation between variables, the correlation matrix of research variables is given (Table 2).

Table 2. The correlation matrix of the research variables

	e-learning flow	Motivation	Computer self-efficacy	Perceived ease of use	Social presence	Cognitive presence	Teaching presence
e-learning flow	1						
Motivation	0.134*	1					
Computer self-efficacy	0.105*	0.245**	1				
Perceived ease of use	0.387**	0.353**	0.186**	1			
Social presence	0.218**	0.312**	0.295**	0.236**	1		
Cognitive presence	0.344**	0.263**	0.153*	0.097	0.260**	1	
Teaching presence	0.317**	0.249**	0.181**	0.027	0.204**	0.388**	1

** $p < 0.01$, * $p < 0.05$

Discussions about rejecting or confirming hypotheses related to the direct effects of variables are performed by Table 3 information.

Table3. Estimates of direct effect coefficients

Variables	Coefficient	t	p
Direct effect of Teaching presence on:			
Social presence	0.20	2.60	0.01
Cognitive presence	0.35	4.74	0.01
Motivation	0.195	2.76	0.01
Computer self-efficacy	0.20	2.57	0.01
e-learning flow	0.32	4.56	0.01
Direct effect of social presence on:			
Perceived ease of use	0.24	3.03	0.01
Motivation	0.36	5.24	0.01
Computer self-efficacy	0.18	2.2	0.05
Direct effect of Cognitive presence on:			
Motivation	0.31	4.33	0.01
e-learning flow	0.29	4.16	0.01
Direct effect of Motivation on:			
Computer self-efficacy	0.24	2.93	0.01
e-learning flow	0.24	3.26	0.01
Direct effect of Computer self-efficacy on:			
e-learning flow	0.28	4.20	0.01

The information in this table shows that all the direct effects defined between the variables are significant. Discussions about rejecting or confirming hypotheses related to the indirect effects of variables are performed by Table 4 information.

Table 4. Estimates of indirect effect coefficients

Variables	Coefficient	t	p
Indirect effect of Teaching presence on:			
Motivation	0.11	2.10	0.05
Indirect effect of Teaching presence on:			
Computer self-efficacy	0.04	1.97	0.05
Indirect effect of Social presence on:			
Motivation	0.07	2.03	0.05
Indirect effect of Motivation on:			
e-learning flow	0.07	2.02	0.05
Indirect effect of Teaching presence on:			
Cognitive presence	0.04	1.97	0.05
Indirect effect of Teaching presence on:			
e-learning flow	0.10	2.07	0.05
Indirect effect of Perceived ease of use on:			
e-learning flow	0.07	2.02	0.05
Indirect effect of Cognitive presence on:			
e-learning flow	0.07	2.02	0.05

The information in this table shows that all the indirect effects defined between the variables are significant. Table 5 compares direct, indirect, and total effects between research variables.

Table 5. Comparison of direct, indirect and total effects

Variables	Direct effect	Indirect effect	Total effect
Effect of Teaching presence on:			
Social presence	0.20	-	0.20
Cognitive presence	0.35	0.04	0.39
Motivation	0.19	0.18	0.37
Computer self-efficacy	0.20	0.04	0.24
e-learning flow	0.32	0.10	0.42
Effect of Social presence on:			
Perceived ease of use	0.24	-	0.24
Motivation	0.36	0.07	0.43
Computer self-efficacy	0.18	-	0.18
Effect of Cognitive presence on:			
Motivation	0.31	-	0.31
e-learning flow	0.29	0.07	0.36
Effect of Motivation on:			
Computer self-efficacy	0.24	-	0.24
e-learning flow	0.24	0.07	0.31
Effect of Computer self-efficacy on:			
e-learning flow	0.28	-	0.28

Investigating the effects of the total effects shows that the highest total effect is related to the effect of social presence on motivation (0.43) and then the total effect of teaching presence on e-learning flow (0.42). Also, among the research variables, teaching presence has the greatest effect on the e-learning flow and social presence has the least effect on computer self-efficacy (0.18). As can be seen in Table 6, in the general model, the highest amount of variance explained in the general model is related to e-learning flow (40%) and the lowest amount of explained variance is related to the social presence (0.04).

Table 6. Explained variance

Variable	Explained variance
e-learning flow	0.40
Motivation	0.35
Computer self-efficacy	0.15
Perceived ease of use	0.06
Social presence	0.04
Cognitive presence	0.19

Fitness characteristics are used to check the fit of the model. In this study, among the various fitness characteristics that exist, the fitness characteristics presented in Table 7 have been used.

Table 7. Goodness fit characteristics of the model

Characteristic	Estimate
chi-square	4.28
df	5
P	0.509
CFI	1
GFI	0.992
AGFI	0.955
RMSEA	0.0014

In this study, the value of chi-square (4.28), the degree of freedom (5), and the value of P is 0.509. Because the value of the statistic (x^2/df) is less than 3 and the value of P is greater than 0.05, these values indicate acceptable fitting. Also, the values of fitness Characteristic (CFI), (GFI), (AGFI) are all greater than 0.9, which indicates acceptable fitting. Finally, since the value of RMSEA is 0.0014, so the model has a goodness of fit (Figure 3).

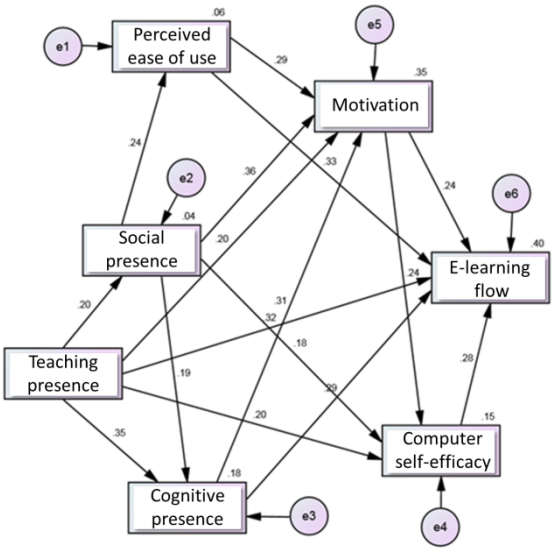

Figure 3. the path diagram and estimation of the fitted model parameters

Discussion

Due to the increasing growth of educational technologies and the increasing role of e-learning flow, teachers and educators should be familiar with the concept of e-learning and the factors affecting it so that they can benefit from the maximum useful time of educational hours. Therefore,

recognizing the effective variables in this process and how to strengthen them will be of great value and will help a lot in increasing the productivity of time.

Considering the findings and results of the present study, the researcher offers suggestions for more efficient and effective use of effective factors in the course of e-learning among students:

1- Considering the results of research on the direct and indirect effects of teaching presence on motivation, social presence, cognitive presence, computer self-efficacy, and e-learning flow, it is recommended that planners plan through educational design and facilitation of educational processes Considering the conditions of the audience age group in the production of software, electronic content and game-based training take an effective step in increasing the effective time of learning and balancing the level of challenge and skill level of students.

2- According to the results of research on the direct and indirect effects of social presence on motivation, cognitive presence, perceived ease of use, computer self-efficacy, and e-learning flow, it is recommended that teachers at different levels of education increase and stimulate students' feelings ineffective communication. And working together on computer-based educational activities through teaching strategies will increase students' motivation, build self-confidence and self-efficacy in the field of computer use and be in the process of e-learning flow. Student research centers are a good place to grow students' social presence in new areas of technology. Therefore, it is suggested that students be directed to these centers, especially during the summer holidays, and school principals should encourage students to work in this field.

3- According to the results of research on the direct and indirect effects of cognitive presence on the motivation and e-learning flow, it is recommended that students increase their power in constructing and validating meanings and concepts through their continuous reflection and discourse on e-learning processes. Such as introducing educational games, making electronic content of textbooks by students (due to students' abilities, even in the form of a simple PowerPoint), and presenting the products mentioned in the class, and also using interactive educational content increases motivation and understanding balance. The level of skill and the amount of challenge in the person to become provides e-learning flow.

4 - According to the results of research on the direct and indirect effects of perceived ease of use on the motivation and e-learning flow, it is recommended to create an understanding of the comfort and relaxation of students when working with computers from software, electronic content and

training based. Use the right game with their age group. Students' backgrounds in using these educational technologies can be a good guide for teachers to choose from. Appropriate grouping in terms of students' ability level when working with computers, the use of appropriate hardware equipment, and the timely use of incentive techniques when working with computers can also strengthen the perceived ease of use to motivate and ultimately provide e-learning flow.

5- According to the results of research on the direct and indirect effects of motivation on computer self-efficacy and e-learning flow, it is suggested that teachers create confidence and self-efficacy by encouraging and strengthening sustainability in the e-learning path and finally e-learning flow in students. This can be done in ways that enhance students' motivation by demonstrating the appeal of educational software, e-content, and game-based learning, as well as the use of instructional content designed in a step-by-step (easy to hard) system. It can play a role in strengthening students' motivation to use computer-related education.

6- According to the results of research on the direct effect of computer self-efficacy on e-learning flow, it is suggested that teachers and educators increase the student's belief in their capability to fulfill an assignment using the computer to create e-learning flow in them. This is accomplished by assigning tasks with a ascending course in difficulty (initially very simple and short tasks) and encouraging the student at the end of each stage to provide the conditions for the student to perform his or her duties as an e-citizen (such as working with a POS machine, Online shopping, urban e-services, etc.), as well as providing an opportunity for the student to teach others what they have learned, can strengthen their computer self-efficacy.

In this study, the factors affecting e-learning flow among students were examined and their direct and indirect effects with each other and with the variable of e-learning flow were tested. In the present research model, other related learning flow models were taken from each of the other theories and models, such as flow and research theory (Nakamura and Csikszentmihaly, 2009), flow experience (Shin, 2006), flow impact and Motivation (Li et al., 2012), the framework of social education and learning flow (Hart, 2014) and the experience of flow in educational games (Sanjamsai and Phukao, 2018) were used.

Due to the validity of all hypotheses in the conceptual model of the present study, it is a good model for schools and educational centers regarding e-learning flow. In addition, the conceptual

model presented in this study validates them by analyzing the fundamental relationships between variables and variables common to other learning flow models.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of Payame Noor University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors contributed to the study conception and design, material preparation, data collection, and analysis. All authors contributed to the article and approved the submitted version.

Funding

The authors did (not) receive support from any organization for the submitted work.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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