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Original Article

An investigation into the Factors Affecting Perceived Enjoyment of Learning in Augmented Reality: A Path Analysis

Maryam Darvishi[1]*, PhD candidate; Mohammad Hassan Seif[1], PhD; Mohammad Reza Sarmadi[1], PhD; Mehran Farajollahi[1], PhD

[1]*Department of Educational Sciences, Payame Noor University, Tehran, Iran*

ABSTRACT

Background: Teaching and learning are undergoing a dramatic transformation thanks to the technological advances in areas like Augmented Reality (AR). The main purpose of this study was to investigate the factors affecting perceived enjoyment of learning in AR.

Methods: This was an applied research in terms of purpose and a descriptive and correlative study in terms of methodology. The statistical population included all undergraduate students at Payam-e Noor University in western areas of Iran during 2019-2020 academic year (n=24000). A sample of 600 students were selected through randomized multistage cluster sampling based on Cochran's formula. The participants used an AR application, and then completed an integrated questionnaire, which was a combination of 5 questionnaires (flow, perceived enjoyment, need for cognition, cognitive absorption and self-efficacy). A total of 556 questionnaires were returned. The data were analyzed through path analysis using Amos 22, Lisrel 8.50 and Spss 22.

Results: Among the direct effects, self-efficacy had the highest effect on perceived enjoyment (0.28) and need for cognition had the lowest effect on self-efficacy (0.16). On the other hand, cognitive absorption had the highest indirect effect on perceived enjoyment (0.13) and the lowest indirect effects were those of the need for cognition on flow (0.04) and self-efficacy on flow (0.04). The highest total effect was related to the effect of self-efficacy on perceived enjoyment (0.28) and the lowest one was related to the effect of self-efficacy on flow (0.04).

Conclusion: The results obtained for the fit indices of the proposed model showed that it had a good fit with the data collected from the respondents (X^2=22.14, P=0.179, CFI=0.99, GFI=0.99, AGFI=0.98 & RMSEA=0.023). Accordingly, this model can provide educators and education leaders with critical information for improving learning outcomes.

Keywords: Augmented reality, Cognitive absorption, Need for cognition, Self-efficacy, Flow, Perceived enjoyment

**Corresponding author:*
Maryam Darvishi, PhD candidate;
Department of Educational Sciences, Payame Noor University, Tehran, Iran
Tel: +98 9183189926
Email: m.darvishi61@yahoo.com

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Introduction

Nowadays, rapid advances in Information Technology (IT) encourage everyone to apply it in their fields of study or work. Augmented Reality (AR) is a product of these developments, and may yield substantial benefits in many areas of life (1, 2). Real and virtual worlds can be linked by new immersive technologies (3). In fact, education is one of the areas wherein new technologies like AR can be put to use. AR was introduced to education in 1990 (4), and was applied in many areas such as mathematics (2), geometry (5), medicine (6) and social sciences (7). Kesima & Ozarslanb (8), define it as a "technology that augments virtual information on top of the real world with continuous and implicit user control of the point of view by the user and computer-generated virtual scenes". Since Enjoyment is one of the factors that affect learners' attention and engage them in virtual activities, more emphasis should be laid on the entertainment aspects of technological systems. Davis et al (9) defined enjoyment as the intrinsic reward derived through the use of the technology. Intrinsic motivation refers to the pleasure in participating in an activity. Enjoyment in virtual settings has been highlighted in many studies (10-13) emphasizing its importance in educational systems. Indeed, making learning activities more enjoyable seems necessary for promoting learners' acceptance and use of mobile learning (10). Jambulingam (14) stated that learners will be more motivated to do or repeat an enjoyable activity compared to a similar but less enjoyable activity. The factors affecting perceived enjoyment have been studied by many researchers like Yi & Hwang (15), Ahmadi Deh Ghotbadini (16), Gou and Ro (17), and Weibel and Wissmath (18).

Self-efficacy is a variable that affects perceived enjoyment as one of the important determinants of human behavior (19). In fact it is a key concept for understanding learning and achievement. It boosts students' self-confidence and helps them determine their future course of action. Learning experiences are conducive to the reinforcement of self-efficacy, leading to greater academic achievements (20). Bandura (21), defined self-efficacy as a "person's own judgment in regarding to realize the capacity to successfully organize necessary events to achieve the objectives given ". Therefore, it has a power that can affect individual's preferences for a specific area and their conduct. In technology domain, computer self-efficacy is defined as individual's self-perceived capability for completing the task or solving the problem using a computer (22, 23). Mobile self-efficacy appears to be a proper term for exploring the concept of self-efficacy with respect to the beliefs and behaviors of mobile users. In this study, mobile self-efficacy is related to the respondents' beliefs about using mobiles to obtain information about their lessons in an augmented reality program. Yi & Hwang (15), and Ahmadi Deh Ghotbadini (16) found a direct relationship between self-efficacy and perceived enjoyment. Elias and Loomis (24) found a positive correlation between the need for cognition and self-efficacy. Weniger and Loebbecke (25) found a close relationship between self-efficacy and cognitive absorption.

Flow experience, a concept originally developed by Csikszentmihalyi (13), is one of the factors affecting perceived enjoyment. In fact, it's an emotional state in which a person is immersed into an activity completely (26). It is satisfying feeling and the individual is intrinsically motivated to repeat the activity for its own sake (12). The gratifying mental state of the flow is recognized by a feeling of energized focus, full engagement and success in the process of the activity (18). Flow state might be experienced in a variety of activities, such as playing instruments, climbing, dancing, working or playing chess (27). Gou and Ro (17) found that flow state had a positive and direct effect on enjoyment. Weibel and Wissmath (18) found that there was a direct and significant relationship between flow and enjoyment.

Cognitive absorption is another variable that could affect perceived enjoyment.

Agarwal & Karahanna (28) introduced the concept of cognitive absorption (CA) and defined it as the "state of deep involvement or holistic experience with IT" (28). They also identified 5 dimensions of the cognitive absorption construct, namely "temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity" (28). Their study and that of Huprich (29) found a close relationship between cognitive absorption and flow.

Finally, perceived enjoyment might be affected by need for cognition, which is characterized by the extent to which individuals engage in effortful cognitive tasks. Also, it is conceptualized as a personality trait that explains individual differences in motivation for cognitive processing, and it is recognized as an important factor for determining the differences in strength and stability of attitudes (30). Petty et al. (31) noted that people with high levels of need for cognition are inclined to think more profoundly about every kind of information including their own thoughts and metacognition. Negahdari et al. (32) claimed that the need for cognition has a direct and positive effect on flow state. Furthermore, Li & Browne (33) found a positive and significant relationship between the need for cognition and flow. Elias & Loomis (24) found a positive correlation between the need for cognition and self-efficacy beliefs.

Finally, in view of the given literature, no study appears to have explored the learning outcomes in Augmented Reality based on the variables in our proposed conceptual model. Augmented reality is a novel technology in education that may affect various aspects of teaching and learning process. It can yield several important outcomes such as enhanced learning enjoyment, which is one of the least appreciated factors in educational systems. It could also be used for solving many problems raised by malfunctions or shortcomings in educational procedures. In fact, this technology can be applied anywhere where there is a lack of resources, or where complementary instructions are required. Therefore, the present study applied path analysis to investigate the factors affecting perceived enjoyment of learning in Augmented Reality.

Methods

This was an applied research in terms of purpose and a descriptive and correlative study in terms of methodology.

Statistical Population: The population included all undergraduate students at Payam-e Noor University in western areas of Iran during 2019-2020 academic year (n=24000).

Sampling Method: Randomized multistage cluster sampling was applied in this study. For this purpose, initially 3 western provinces (Hamedan, Kermanshah and Chaharmahal-o Bakhtiari) were randomly selected from a total of six. Then the humanities group was selected from among all educational groups. Afterwards, the researchers singled out three study programs in humanities available at all PNU centers (educational sciences, psychology and consulting). Finally, a textbook entitled *English in Psychology 1*, which is commonly used in all the mentioned programs, was selected for AR instruction.

Sample Size: A total of 600 students were selected based on Cochran's formula.

Inclusion and Exclusion Criteria: The inclusion criteria included studying in one of the aforementioned programs in second, fourth, sixth and eighth semesters (the course under study is held only in even semesters), taking *English in psychology1* course in that semester and willingness to participate in the study. The exclusion criteria included submitting incomplete questionnaires or studying in odd semesters.

Procedure: The researchers first introduced themselves to the participants and informed them of the purpose of the study. The participants were assured that their information will remain confidential. Their informed personal consent was obtained before the start of the study. Then, they installed the AR application on their

cellphones and used supplementary course materials besides their textbook. In total, fifteen AR sessions were held within a 15-week period (15 lessons altogether), and each session lasted 90 minutes. By the end of the AR program, an integrated questionnaire was completed by the students and 556 questionnaires were returned.

Descriptive (mean and standard deviation) and inferential statistics indices were used for data analysis. Path analysis was applied in the inferential part to investigate the direct, indirect and total effects of variables on each other. The software programs used in this study included SPSS 22 for descriptive statistics section, LISREL 8.50 for path analysis, and AMOS 22 for factor analysis.

The study variables were categorized into 3 groups: perceived enjoyment (criterion variable), cognitive absorption and need for cognition (predictor variables), and self-efficacy and flow (mediator variables). An integrated questionnaire (including 5 standard questionnaires) was used to assess the variables. The components of the integrated questionnaire were as follows: flow (14 items), perceived enjoyment (10 items), need for cognition (18 items), cognitive absorption (18 items) and self-efficacy (6 items).

All items of the integrated questionnaire were scored on a five-point Likert scale (1=strongly disagree, 5=strongly agree). The validity of the questionnaires was established by confirmatory factor analysis, which showed an appropriate correlation coefficient between the variables. The structural validity of the each of questionnaires was previously confirmed by various researchers. Also, the validity of the questionnaires was confirmed by a group of faculty members and experts in educational sciences. The minimum and maximum obtainable scores were 66 and 330 respectively. The questionnaires that were used as the measurement tool of the study were as follows:

Need for Cognition: This scale was developed by Cacioppo & Petty (30). It comprises 18 items, nine of which are scored reversely. The variable is rated on a five-point Likert scale (1=extremely uncharacteristic of me, 5=extremely characteristic of me) (34, 35). In their study, Negahdari et al. (32) reported a Cronbach's alpha coefficient of 0.75 for this variable. Cronbach's alpha coefficient for the reliability of the questionnaire stood at 0.81 in the present study. This coefficient was measured at 0.88 in Rastegar's study (36).

Perceived Enjoyment: This variable was measured by Systems Skill development and Systems Flexibility that was developed by Nassuora (2012) and Vosloo, (2012) as cited by Mubuke et al. (10). The questionnaire has 10 items that are rated on a five-point Likert scale. In their study, Mubuke et al. (10) reported a Cronbach's alpha coefficient of 0.897 for this variable. Cronbach' alpha coefficient for the reliability of the questionnaire was found to be 0.75 in the present study.

Flow Short Scale: A shortened form of this scale was used in the present study. It has 14 items that are scored on a five-point Likert scale (1=strongly disagree, 5=strongly agree). Kazuki et al. (37) calculated a Cronbach's alpha coefficient of 0.918 for this variable. Cronbach' alpha coefficient for the reliability of the questionnaire stood at 0.85 in the present study.

Cognitive Absorption: Agarwal's & Karahanna's (28) Cognitive Absorption questionnaire was used to assess this variable. The questionnaire contains 19 items scored on a five-point Likert scale (1=strongly disagree, 5=strongly agree). In their study, Reychav et al. (38) reported a Cronbach's alpha coefficient of 0.856 for this variable. Cronbach' alpha coefficient for the reliability of the questionnaire was 0.76 in the present study.

Self-Efficacy: Given that the present study aimed to examine self-efficacy in a virtual environment, mobile self-efficacy questionnaire constructed by Mahat et al. (39) was used to assess this variable. It has 6 items rated on a five-point Likert scale (1=strongly disagree, 5=strongly agree). In their study, Mahat et al. (39) registered a Cronbach's alpha coefficient of 0.638 for this variable. Cronbach' alpha coefficient for the reliability

of the questionnaire was 0.82 in the present study. It should be noted that the reliability of the integrated questionnaire in the present study was 0.83 (Figure 1).

Results

The statistical sample included 600 undergraduate students at Payam-e Noor University (12.3% male and 87.7% female), and their average age was 21 years. Among them, 39% were studying psychology, 28% consulting and 33% educational sciences.

Table 1 indicates the fitness indices of the study.

Descriptive statistics and correlation matrix of the research variables are represented in Table 2.

As shown in Table 2, considering that the skewness and kurtosis values of the research variables lie between -2 to +2, we can assume that they have a normal distribution. Therefore, path analysis can be applied for data analysis, and accordingly correlation matrix of study variables is presented in Table 3.

As indicated in Table 3, flow has the highest effect on perceived enjoyment, whereas the lowest effect is related to the need for cognition.

Table 4 demonstrates the direct effects of variables on each other. This part belongs to the direct effects of variables on the basis of the data presented in Table 3.

As indicated in Table 4, the highest direct effect is the effect of self-efficacy on perceived enjoyment (0.28) and the lowest direct effect is that of need for cognition on self-efficacy (0.16). It should be noted that all the direct

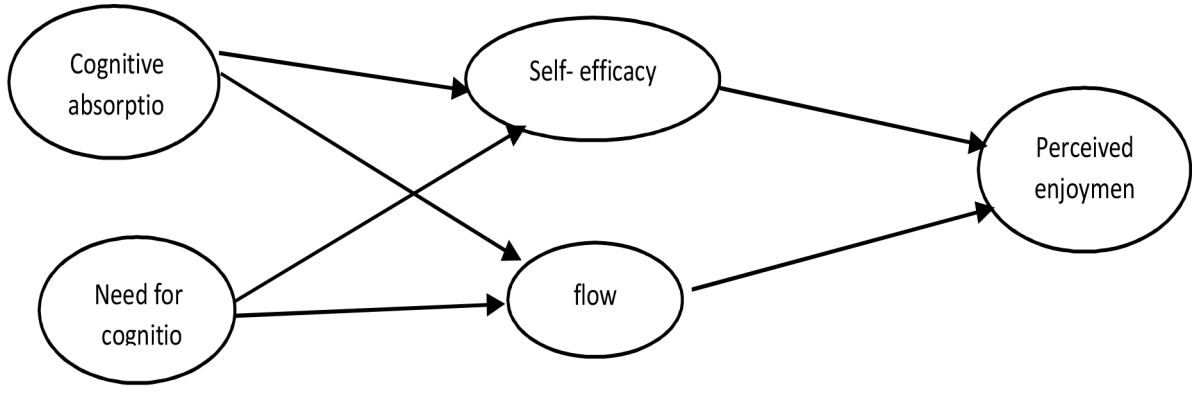

Figure 1. conceptual model of the study

Table 1. fitness indices of the study

Questionnaire	Fit indices				Validity	Reliability
	X^2	df	RMSEA	AGFI		
Flow	64.837	53	0.020	0.968	CVI-CVR	0.85
Enjoyment	23.890	20	0.019	0.977	CVI-CVR	0.75
Need for cognition	104.827	95	0.014	0.963	CVI-CVR	0.81
Self-efficacy	1.181	5	0.000	0.997	CVI-CVR	0.82
Cognitive absorption	120.298	98	0.020	0.960	CVI-CVR	0.76
Integrated questionnaire	287.302	99	0.031	0.983	CVI-CVR	0.83

Table 2. Descriptive statistics of the research variables.

Variables	Mean	Standard Deviation	Skewness	Kurtosis
Cognitive absorption	64.36	1.16	-0.88	1.97
Need for cognition	64.09	9.28	1.92	-1.16
Self-efficacy	21.15	4.43	1.04	1.10
Flow	44.76	1.17	-0.58	0.09
Perceived enjoyment	31.87	9.83	-0.47	-0.47

Table 3: Correlation matrix of variables

Variables	1	2	3	4	5
Cognitive absorption	1				
Need for cognition	0.160**	1			
Self- efficacy	0.227**	0.203**	1		
Flow	0.334**	0.292**	0.240**	1	
Perceived enjoyment	0.234**	0.147**	0.354**	0.382**	1

**<0.01

Table 4. Estimation of direct effects coefficients

Variables	Standardized parameters	t	Significance level
Effect of cognitive absorption on:	-	-	-
Self-efficacy	0.25	6.13	0.01
Flow	0.26	7.04	0.01
Effect of need for cognition on:	-	-	-
Self-efficacy	0.16	3.99	0.01
Flow	0.19	5.06	0.01
Effect of self-efficacy on:	-	-	-
Perceived enjoyment	0.28	7.67	0.01
Effect of flow on:	-	-	-
Perceived enjoyment	0.21	5.44	0.01

Table 5. Estimates of indirect effect coefficients

Variables	Standardized Parameter	t	Significance Level
Cognitive absorption on:	-	-	-
Perceived enjoyment	0.13	6.69	0.01
Need for cognition on:	-	-	-
Perceived enjoyment	0.09	5.47	0.01
Flow	0.04	3.30	0.01
Self- efficacy on:	-	-	-
Flow	0.04	3.34	0.01

effects of variables were significant at 0.01 level. Table 5 indicates the indirect effects of variables on each other. As illustrated in this table, the highest indirect effect is that of cognitive absorption on perceived enjoyment (0.13) and the lowest ones are those of need for cognition on flow (0.04) and self-efficacy on flow (0.04).

It should be noted that all the indirect effects were significant at 0.01 level. Another parameter that can be obtained from a combination of direct and indirect effects is the total effect of each variable in the study (Table 6).

Table 6 indicates that the highest total effect is that of self- efficacy on perceived enjoyment (0.28) and the lowest one is the effect of self-efficacy on flow (0.04). Furthermore, all the total effects were significant at 0.01 level. The explained variances of research variables are represented in Table 7. As it can be seen in the table the highest variance belongs to the perceived enjoyment (0.028) and the lowest one belongs to the self- efficacy (0.10).

Fitness indices were used to investigate the model fitness. Among the various types of fitness indices, the ratio of chi square to degrees of freedom (x^2/df), P value, comparative fit index (CFI), goodness-of-fit index (GFI), adjusted goodness of fit index (AGFI), and root mean square error of approximation

(RMSEA) are represented in this study. These features are presented in Table 8.

Table 6. Estimates of total effect coefficients

Variables	Total effects	T	Significance level
Cognitive absorption on:	-	-	-
Self- efficacy	0.25	6.13	0.01
Flow	0.26	7.04	0.01
Perceived enjoyment	0.13	6.69	0.01
Need for cognition on:	-	-	-
Self-efficacy	0.16	3.99	0.01
Flow	0.23	6.24	0.01
Perceived enjoyment	0.09	5.47	0.01
Self- efficacy on:	-	-	-
Perceived enjoyment	0.28	7.67	0.01
Flow	0.04	3.34	0.01
Flow on:	-	-	-
Perceived enjoyment	0.21	5.44	0.01

Table 7. Explained variance of research variables

Variable	Explained Variance
Perceived enjoyment	0.028
Self-efficacy	0.10
Flow	0.27

Table 8. Fitness indices of the variables

Characteristics	Estimation
Ratio of chi square to degrees of freedom	22.140
P value	0.179
Comparative fit index	0.99
Goodness-of-fit index	0.99
Adjusted goodness of fit index	0.98
Root mean square error of approximation	0.023

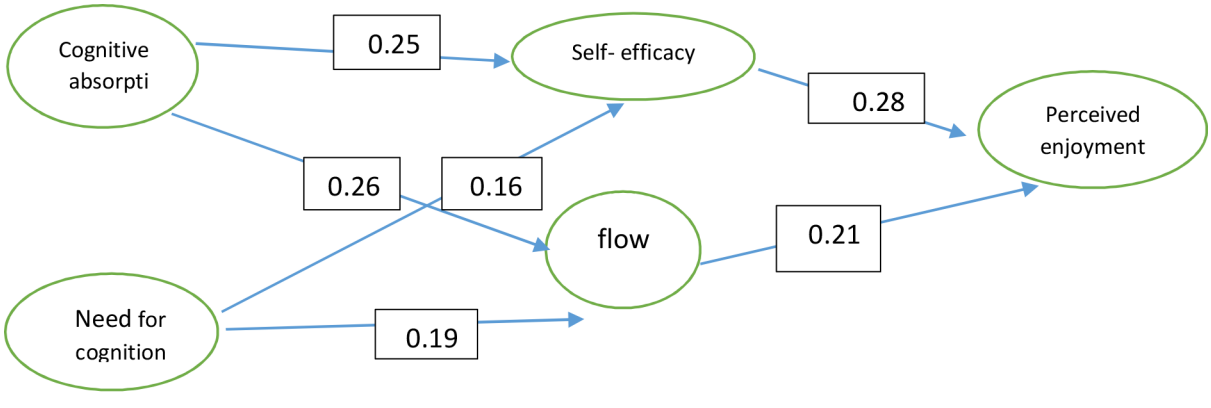

Figure 2. The Fitted Model for the Whole Sample with Standard Coefficients

Table 8 reveals that the model has a good fitness. The fitted model along with estimated parameters (standardized parameters) are presented below (Figure 2).

Discussion

The results showed that the direct effect of cognitive absorption on self-efficacy (0.25, t=6.13, Significance level=0.01) and flow (0.26, t=7.04, Significance level=0.01) was positive and significant. It appears that students can better engage with the given content and find it more appealing when they are drawn to the subject matter and concentrate on it.

Moreover, such contents help students focus on a task for longer periods. Being immersed in the content, they can follow the steps without help and successfully complete the task. These findings are consistent with those of Weniger & Loebbecke (25), Huprich (29) and Agarwal & Karahanna (28). Educators and policy makers are encouraged to provide more engaging educational content with the aim of fostering students' interest and persistence in academic activities. This will improve their sense of self-efficacy and help them rely on their own potentials in their academic works.

The direct effect of the need for cognition on self-efficacy (0.16, t=3.99, Significance level=0.01) and flow (0.19, t=5.06, Significance level=0.01) was positive and significant. Students with abstract thinking and a sense of responsibility appear to enjoy a higher level of self-confidence, and they can better organize strategies to reach their goals. Furthermore, students who demonstrate higher levels of thinking and have their own style for achieving success tend to feel more competent and can easily concentrate on their tasks. Therefore, they may immerse themselves in an activity and not feel the passage of time; the activity becomes more appealing and they are more likely to succeed. These findings are in line with those of Elias & Loomis (40) and Negahdari et al. (32) and Li & Browne (33). Policy makers are recommended to prepare educational settings in a way that students can develop their own thinking skills, cultivate a sense of responsibility, and feel competent enough to solve complicated problems. Besides, when the educators focus on training students about deep thinking and creation of their own styles, students get flow state easily and enjoy activities they are working on.

The direct effect of self-efficacy on perceived enjoyment (0.28, t=7.67, Significance level=0.01) was one of the other findings of the study. Having a sense of self-efficacy and competency appears to make for a pleasing learning experience and instills curiosity in students. This is consistent with the studies by Ahmadi Deh Ghotbadini & Meshkani (16) and Yi & Hwang (15). Accordingly, decision makers and educators need to hold workshops and in-service courses for teachers with the aim of helping students realize their potentials and making activities more enjoyable and appealing for them.

The direct effect of flow on perceived enjoyment was positive and significant (0.21, t=5.44, Significance level=0.01). This result implies that the learning process becomes more enjoyable when students have high levels of flow in their academic works and fully engage in learning activities. They like to continue working on academic tasks without paying attention to other environmental stimuli. This is in agreement with the findings of Gou & Ro (17) and Weibel & Wissmath (18). Hence, in order to maintain student engagement in the learning process, education officials should pay special attention to the appealing features of educational contents and activities. Because when the content or activity is attractive the students are aroused to continue that by nature and get more enjoyment of them.

The other finding of this study was the indirect effect of cognitive absorption on perceived enjoyment (0.13, t=6.69, Significance level=0.01). As can be seen, cognitive absorption had a positive and significant effect on perceived enjoyment with mediating role of self-efficacy and flow. In this respect, it can be argued that students' full engagement and the subsequent positive outcomes will lead to a greater sense of self-efficacy and lead to more enjoyment and fun. Also, cognitive absorption can result in a higher flow state whose outcome will be a high level of enjoyment. Therefore, it is strongly recommended that instructors and authorities reinforce the sense of self-efficacy by stimulating deep student engagement in academic tasks, which can in turn lead to a sense of enjoyment. On the other hand, making the contents challenging in a balanced manner and clarifying the learning objectives will add up to the enjoyable experience and boost students persistence in learning.

The last finding was the indirect effect of

the need for cognition on perceived enjoyment (0.09, t=5.47, Significance level=0.01). As evident, the need for cognition had a positive and significant effect on perceived enjoyment with mediating role of self-efficacy and flow. This result suggests that students with high levels of need for cognition prefer complicated problems over simple ones and enjoy thinking for long periods. Accordingly, they usually immerse themselves in a task no matter how long it takes since they find it appealing and enjoyable. On the other hand, focusing on complicated and challenging problems reinforces self-efficacy, which in turn generates more enjoyment. Accordingly, all authorities and instructors should prepare the preliminaries for instilling a sense of need for cognition among students. For that purpose, they need to enhance the challenging features of academic tasks so that students are encouraged to think and engage in a flow state that helps them find joy in problem solving.

Finally, since this study highlighted perceived enjoyment as an important factor that affects the learning outcome, future researchers are advised to consider other variables and investigate the role of other mediating variables that could influence perceived enjoyment. For instance, they can investigate outcomes such as self-esteem, academic engagement, and learning satisfaction, and mediating variables like self-regulation, academic emotions and learning behaviors.

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Authors' Contributions

MD: proposed the research idea and wrote the paper.
MHS: collected the research resources and monitored the writing process.
MRS: revised the paper.
MF: responded to the reviewers.

Ethical Considerations

This research was conducted under the supervision of Payame Noor University. The researchers introduced themselves to the participants and informed them of the purpose of the study. Students were assured that their information will remain confidential. The participants' informed personal consent was obtained before the start of the study.

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Conflict of interest

The authors declare that there is no conflict of interest in this study.

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