

The relationship between computer games and computer self-efficacy with academic engagement: the mediating role of students' creativity

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Abstract

Recent developments in EFL) English Foreign Language) have intensified the need for computer games (CGs). However, far too little attention has been paid to this issue. The sample was selected using the two-stage cluster sampling method in this descriptive and correlational study. In the first stage, two institutes for males were randomly selected from 10 institutes (20 institutes for females and 10 institutes for males) from Zanjan city, and 453(lower and upper-intermediate based On Oxford Placement Test) were scrutinized. Of this sample, 25 people did not want to answer, 26 questionnaires were incomplete, and 402 correct questionnaires were examined. Data was collected by using these questionnaires: Computer Game Questionnaire by Sharifi et al.; Academic Engagement questionnaire by Ramazan Ali Zarandag; Creativity by Torrance and was standardized by Seif Hashemi, and Computer Self-Efficacy Questionnaire - A researcher-made questionnaire was used for this variable and it was standardized. The results showed a significant relationship between CG's experience, computer self-efficacy (CSE), creativity, and academic engagement (AE). This study implies that CGs, CSE, and creativity play an important role in AE. According to the results of the study, it is suggested that CGs-creativity- and network-related classes and courses be held in educational institutions to increase their skills in the field of computers and the Internet. Likewise, CGs and CSE should be addressed more systematically in educational institutions.

Keywords Academic achievement · Computer Games · Computer self-efficacy · Creativity

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1 Introduction

One of the obvious manifestations of the world ahead is using new technologies in various areas of life (Mohammadjani & Safarnavadeh, 2014; Pliushch & Sorokun, 2022). In recent decades, with the introduction of these technologies, traditional approaches to learning have undergone fundamental changes (Pourroostaei Aardakani & Arefi, 2017). Today's education requires new methods, which can be taught in less time and with more depth (Aghveranluei et al., 2021). Since our daily lives are constantly changing with the digital world, creating new ways of learning using technology is a basic need (Kidd & Crompton, 2016). CGs can be mentioned as one of the technologies considered by researchers today. CGs or video games are interactive software programs designed primarily for entertainment. These games refer to games played through personal computers or game consoles. The action requires fast processing of information and presentation of logical and rapid information (Zanganeh, 2015). CGs are a form of entertainment designed to achieve specific goals and have certain rules (Demirbilek & Tamer, 2010; Liu et al., 2022). Today's children grow up with CGs. The attractiveness of this type of game makes people stay in front of the computer and other gaming devices for many hours and engage with it (Kickmeier-Rust & Albert, 2010). In addition to the entertainment aspect, CGs can also be considered a source of learning (Squire, 2006). It can be said that an educational computer game is an activity that helps students learn a lesson in which they have difficulty (Taghavi Jelodar & Hami, 2018). Ito (1998) states that "educational computer games take into account a specific subject or educational content of a particular course and can be appropriate for any type of learning environment"(p.10). Also, Gredler (2004) states: Educational computer games can be used for all four educational purposes: (1) Training, reconstruction, and skills already acquired. (2) Identify gaps and weaknesses in one's knowledge and skills. (3) Review or summarize the existing knowledge and skills of the person before holding an exam. (4) Creating relationships between concepts and principles: These goals are not necessarily independent of each other. A great game for reviewing and summarizing may create a new relationship between concepts and principles (Gredler, 2013). Prensky(2005) believes that the CG approach is effective in teaching and learning for three main reasons: (1) Add engagement (2) Use the interactive learning process (3) Different ways in which the two (game and learning) go hand in hand.

In the last few years, the impact of different technologies on various educational and psychological variables at different educational levels has been examined. Educational computer games are no exception to this rule. More or less, the effect of different technologies on the variables of CGs and CSE with AE and creativity has been investigated, and the research on the effect of CGs on the above variables is also evident. However, the impact of educational computer games on these variables is rarely seen, so this study aims to investigate the impact of educational computer games on the relationship between CGs and CSE with AE: The mediating role of students' creativity.

2 Review of literature

2.1 Academic engagement

The theoretical background of AE is related to Kearsley and Shneiderman, (1998) who served as the conceptual framework for the research. AE theory holds that students that are involved intellectually, socially, and behaviorally lead enhanced learning. In recent years, the impact of different technologies on various psychological variables at varying levels of education have been studied. Educational computer games are no exception to this rule. One of the most important variables that are less addressed is AE. In general, AE can be considered as one of the cognitive (individual) variables affecting educational instruments. Wang (1993) has the most significant impact on AE (Appleton et al., 2013). The structure of AE was first proposed to understand students' academic failure in a theoretical model (Eriksen & Bru, 2022). In recent years, AE, used by some researchers, refers to the quality of student engagement in purposeful educational activities.

2.2 Creativity

The theoretical background of creativity comes back to Vygotsky (1930). In his book: Imagination and Creativity in Childhood (1995/1930), he goes further and develops his theory of creativity. The book describes how Vygotsky regards the creative process of human consciousness, the relationship between emotion and thought, and the role of the imagination.

The study of variables related to AE is one of the leading research topics in educational systems (Fallah et al., 2022; Nami et al., 2014; Scotta et al., 2022). One of the variables affecting AE is creativity. Several researchers have studied the relationship between creativity and AE. According to studies, there is a strong relationship between creativity and AE. The study of the relationship between creativity and AE dates back to the 1962s when Gatzels and Gatzels (1962) first reported their research findings) Nami et al., 2014). Guilford (1967) introduces convergent thinking and divergent thinking as two primary forms of human thought, converging thinking with intelligence and divergent thinking with creativity. The difference is that in convergent thinking, the result of the action is already known; there is always a right or wrong answer, while in divergent thinking, there is no definite answer, and there may be many possible answers that are logically all right. Creativity is the ability to create or produce something new or a new solution to a new problem, method, or instrument. Lu and Kaiser (2022) describe creativity as a process of sensitivity to problems, deficiencies and gaps in knowledge, hidden elements and inconsistencies between them, searching for solutions, providing conjectures and formulating hypotheses, changing and re-formulating them, testing results, and finally defining the relationship between the results. Researchers believe that the environment in which children live can foster creativity and hinder it. Although children may have an innate and genetic ability to be creative, parents and teachers play an important role in promoting creativity (Datu et al., 2022). In rooting out the causes in informal and formal educational environments, a major factor is the neglect of dynamic and creative education. In different aspects of planning goals, content, methods, and evaluation system, the role of the educator as the central pillar of the educational system in the evaluation and fostering of creativity has a special place and value (Casuso-Holgado et al., 2022).

2.3 Self-efficacy and computer self-efficacy

The theoretical background of self-efficacy refers to an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments (Bandura, 1977). Self-efficacy reflects confidence in the ability to exert control over one's motivation, behavior, and social environment.

Another influential variable that may affect AE is self-efficacy. Self-efficacy is one of the variables studied by researchers in various research fields and refers to people's beliefs about having control over life events (Hong et al., 2022; Ozkan et al., 2014; Shaw et al., 2005). Belief in self-efficacy is one of the most important concepts in Bandura's learning theory. The individual considers their capacity and ability to organize the activities required to perform specific tasks and accomplish them (Ozkan et al., 2014). Accordingly, self-efficacy is influenced by the four sources of mastery experiences, substitution experiences, verbal persuasions, emotional and psychological conditions (Zeto et al., 2014). In Bandura's (1986) self-efficacy theory, beliefs about ability are positive. One of the fundamental aspects of self-efficacy is the belief that a person affects different outcomes by exercising control (Liu et al., 2022; Rajabi, 2006). Much research has been done on self-efficacy and its relationship with specific activities, behaviors, and programs. Measuring self-efficacy in particular skills can involve detailed information and different areas and aspects. Accordingly, the role of self-efficacy on the computer can be discussed among various skills. The self-efficacy scale reflects a set of computer-related knowledge, achieving high scores on such scales and indicates the degree of confidence that the individual has in relation to their ability to work with the device (Aldhahi et al., 2022).

In the context of computer use, CSE refers "to a judgment of one's capability to use a computer" (Compeau & Higgins, 1995, p. 192). Bakers and Schmidt (2001) argue that CSE describes the expectation of dominance. Individuals form their expectations of possible future successes and failures based on past failures and successes in learning situations, particularly in technology. Therefore, CSE helps people expect positive consequences (Barrett et al., 2018; Minott, 2021; Umirov & Khudayberdiev, 2022).

Akpan's (2018) study showed that CSE was the most important relationship between anxiety and computer anger. Dodge and Natividad (2018) showed that students had slight computer anxiety and normal attitudes toward the Internet. Ball's (2019) study predicted that CSE, computer anxiety, and technology would significantly affect teachers' motivation to use educational technology in the traditional classroom. Al-Hilawani's (2018) study showed that adolescents improved their IQ, reaction time, and movement time due to playing CGs.

2.4 Computer games

Another variable affecting AE is the variable of CGs. Technology is gradually evolving in human life. Computers with great graphics systems allow people to produce complete CGs. The computer game industry has developed various games such as simulation, first-person adventure, fantasy, etc. (Aghveranluei et al., 2021; Kibritchi,2007; Liu et al., 2022; Mayer et al. 1999; Mohammadjani & Safarnavadeh, 2014; Pliushch & Sorokun, 2022; Slyman, 2022; Uram & Skalski, 2022). CGs, which have been called the most popular games for children and adolescents of this period, can threaten their mental and physical health.

Still, the impact of these games on the creativity and mental development of children and adolescents cannot be ignored. The impact of children and adolescents on CGs reaches the highest possible level; based on the research, children learn 20% of what they hear and 40% of what they observe. This amount is more than 75% of what they see, hear, and work with at the same time. Accordingly, children and adolescents see, hear, and are interested in CGs due to the fun. Entertainment nature of the game, they are willing to play for hours, and they are strongly influenced by the content of such games (Mayer, 2019). Computer video games have been around for nearly 50 years. Recent findings also show that the valuable content of CG has great potential to improve the lives of children and adolescents. However, games with violent and anti-social content increase the scope of their negative consequences.

However, researchers have argued that a more balanced approach is needed to understand the impact of CGs on the development of children and adolescents (Abtahi & Naderi 2011; Anisimov & Inshakova, 2022; Nami et al., 2014; Rahnama & Abdolmaleki, 2009; Salsenio, 2014), and indirectly inconsistent with the research results of Hajloo et al. (2011), Rashidi and Shahrarai (2008), Hassanzadeh and Imanifar (2010) and Hosseini Nasab and Sharifi. The effectiveness of media such as CGs with their capabilities and features has surpassed other media. These games use many learning principles such as empathy, practice, repetition, reward, and reinforcement (Uram & Skalski, 2022). CGs can indirectly teach the child skills that will lead to significant business and career success. The designers of CGs have also moved in a direction where these CGs are close to real life. In terms of scenario, it is completely diverse, and in terms of graphics, it is simulated daily life, and in terms of games, it is closer to playing roles.

Psychologists consider helping coordination, a better understanding of space, solving math problems, increasing vocabulary, and social experience as positive consequences of these games. Kibritchi's (2007) research shows that students who learned mathematics from CGs made more progress than students trained in the usual way. Abd-Alrazaq et al. (2022) showed that playing these games in adolescents and young adults increases computer literacy and perceptual skills. Denise's study showed that 62% of prospective classroom teachers had computers at home. The results of Angelopoulou et al.'s (2022) study showed that computer use and educational use have a close relationship with the personal self-efficacy of pre-service teachers in teaching science with computers. The study results by Ornes (2019) showed an improvement in IQ, reaction time, and movement time of adolescents due to playing CGs. Plasman et al. (2022) showed that computer training technologies are practical teaching instruments to increase psychomotor skills in surgery. Young surgeons with computer technology perform better in surgery, especially laparoscopic surgery, than their peers.

Therefore, paying attention to computer technologies in surgical internships can help improve the psycho-motor skills of surgeons and the interaction between them and the interface screen used in surgery. The study of Hwang and Chen (2022) showed that the computer game-based teaching method effectively supports mathematical academic achievement, motivation for progress, and attitude towards mathematics but does not affect avoidance motivation. Some studies have shown that CGs contribute to academic failure, as they take up a lot of people's time and engage their minds in non-educational matters (Slyman, 2022). Considering the importance of the variables of self-efficacy, CGs, and creativity in AE, this study aims to investigate the relationship between CG and CSE with AE: The mediating role of students' creativity.

2.5 Learners' creativity and AE

Creativity means the creation of new and useful ideas and opinions by an individual or the collaboration of a group of people (Chemi, 2023). Creativity is not a structure or a single phenomenon, but a concept in the form of a scientific label that is used for various human actions or actions that can lead to new and valuable results (Zaeske et al., 2023). For a person to be recognized as a creative person, he must show four characteristics that are considered necessary for creativity. These characteristics include fluency, flexibility, originality, and elaboration (Emami et al., 2023). Along with fostering creativity, AE is also very important. Academic conflict is a construct that was presented for the first time to understand and explain academic failure. AE is self-initiated and purposeful participation in academic affairs and activities, which indicates a stable psychological investment and learning facilitators along with positive emotional states in the extent of individual efforts. Efforts that seek to improve and promote the understanding or mastery of knowledge, skills, or professions are the goal of the education program (Beghetto, 2023).

For this purpose, four hypotheses were formulated:

Hypothesis 1 CGs have a significant relationship with AE in English language learners.

Hypothesis 2 CSE has a significant relationship with AE in English language learners.

Hypothesis 3 Creativity has a significant relationship with AE in English language learners.

Hypothesis 4 CGs have a significant relationship with AE and the mediating role of creativity in English language learners.

3 Methodology

3.1 Statistical population

The statistical population of the present study includes all language learners' institutes in Zanjan institutes, Iran. The total number of language training centers was 30 (20 institutes for females and 10 institutes for males). The sample was selected by a two-stage cluster sampling method. In the first stage, two institutes from males were randomly selected, and 453 of them were studied. Of these, 25 people did not want to answer, 26 questionnaires were incomplete, and 402 correct questionnaires were examined. To elicit information about students' proficiency, and to get a homogeneous group, the Oxford Quick Placement Test was used in the following rating method: 1–17 Beginner, 18–27 Elementary, 28–36 Lower-intermediate, 37–47 Upper-intermediate, 48–55 Advanced, 56–60 Very advanced.

3.2 Validity

The content validity of the computer game questionnaire was examined by CVI (Content validity index) and CVR (Content validity ratio) methods and using the views of 20 experts. The CVR formula is calculated by dividing the number of participants who answered by the number of users who clicked on the questionnaire and then multiplying by 100. CVI is computed as the number of participants giving a rating of 3 or 4 to the relevancy of each item, divided by the total number of participants. The results are as follows: Note that the CVR index for 20 people should be greater than 0.42, and CVI should be greater than 0.79.

Table 1 shows the CVI and CVR values for each question and all questionnaires. The CVI and CVR values for the whole questionnaire are 0.7 and 0.9, respectively, and higher than 0.42 and 0.79, and for items, this assumption is also valid.

3.2.1 Factor validity

To use structural equations, factor validity is required, the results of which are presented in the following table:

The KMO and Bartlett test evaluate all available data together. A KMO value over 0.5 and a significance level for Bartlett's test below 0.05 suggests there is a substantial correlation in the data.

According to Table 2, the KMO values for CGs, CSE, creativity, and AE questionnaires are 0.776, 0.868, 0.856, and 0.872, respectively. It shows that the volume of data is suitable for factor analysis and also according to the amount of surface covered by the Chi-square statistic (significance level) Bartlett index for all variables and their dimensions was equal to (0.001), which was less than 0.01 and showed the data is well correlated.

Table 1 CV	and CV.	R Results	: of Compute	er Game Ç	Juestionnaire										
question	n _E	n _{E1}	CVR	CVI	I question	nE	n _{El}	CVR	ن م	VI questic	on n	E n _{E1}	Ð	VR	CVI
1		15	18	0.5	0.9	5	11	14	0.1	0.7	6	18	19	0.80	0.95
2		11	11	0.1	0.55	9	17	18	0.7	06.0	10	13	14	0.30	0.7
3		16	17	0.6	0.85	٢	18	19	0.8	0.95	11	15	18	0.50	0.90
4		16	15	0.6	0.75	×	17	13	0 0	0.65					

Table 2 KMO And Bartlett Tests to Evaluate the Adequacy of	Variables	КМО	Bartlett's Test of Sphericity	df	Sig
Sampling and Data Correlation	CG	0.0.776	28029.620	496	0.001
	CSE	0.868	1586.554	21	0.001
	Creativity	0.856	26254.223	524	0.001
	AE	0.872	36521.015	689	0.001

3.3 Reliability

To evaluate the reliability of the research questionnaires, Cronbach's alpha coefficient was used. The results showed that Cronbach's alpha for CGs was 0.8890, CSE was 0.898, Creativity was 0.980, and AE was 0.97.

3.4 Instruments of data collection

Due to the fact that in different research projects, the researcher's goal is different, the researcher may not be able to use the same instruments used in previous research; Data collection instrument is an instrument that helps the researcher collect and record the necessary data. The researcher decides what instrument to use to collect his data based on his research method and the type of data he intends to collect.

3.5 Questionnaires

3.5.1 Computer game questionnaire

In this research, CGs are one of the 7 questions of Sharifi et al.'s (2011) CG questionnaire. This questionnaire includes questions about the level of familiarity, the effect of games on education, the level of parental supervision, as well as the place of the game, and the hours of the game. The Torrance Creativity Test (1986), standardized by Seif Hashemi, was run to measure creativity. CSE Questionnaire - A researchermade questionnaire was used for the CSE variable and it was standardized.

The AE questionnaire was introduced by Ramazan Ali Zarandag (2012). Zarandag, in his research to measure AE, used the researcher's questionnaire. It was 45 items then it was reduced to 41 items. Afterward, expressions were arranged based on the items, and in a preliminary study, a questionnaire with 38 items was performed.

4 Results

To analyze the data in two sections of descriptive statistics and inferential statistics, SPSS 25 and Amos 24 software are used. First, the descriptive statistics section presents the central indicators and the dispersion of research variables. The results are shown in Table 3.

The descriptive statistics in Table 3 show that the mean variables of CGs, CSE, Creativity and AE are equal to 18.946, 88.754, 96.300, and 101.869 with deviations of 6.215, 15.729, 29.697, and 36.335, respectively. Also, the Skewness and Kurtosis

variable	N	Mean	Std. Deviation	Minimum	Maximum	Skewness	Kurtosis
CG	402	18.946	6.215	9	28	0.063	-1.379
CSE	402	88.754	15.730	48	146	-0.183	0.518
Creativity	402	96.300	29.697	43	150	-0.352	-1.327
AE	402	101.869	36.335	45	177	0.277	-1.145

 Table 3 Central Indicators and Dispersion of Research Variables

indices are in the range (2- and 2) and show that the distribution of variables is almost expected.

4.1 Assumptions of structural equation methods - path analysis

4.1.1 Default 1: kolmogorov-smirnov test

To check the normality of the research variables, the Kolmogorov-Smirnov normality test is used, the results of which are as follows:

Based on the results of Table 4, it was observed that the sig value is greater than 0.05, and the assumption of normal data is accepted.

4.1.2 Default 2: Pearson correlation test

To investigate the correlation of research variables, the Pearson test was used, the results of which are as follows:

The results of the Pearson test in Table 5 showed:

The correlation coefficient of AE with CG, CSE, and creativity are 0.743, 0.704, and 0.665, respectively, which is significant at the level of 0.05. Creativity with CG and CSE is equal to 0.704 and 0.674, respectively, and is significant at 0.05. Also, the correlation coefficient of CG and CSE is equivalent to 0.743 and is significant at the level of 0.05.

The path analysis method with Amos 24 software is used to investigate the relationship between research variables. The research model is as follows (Figs. 1 and 2):

The relationship between computer games, computer self-efficacy, and creativity with academic engagement.

The model was fitted in Amos24 software. The results were obtained as follows:

Table 4 Evaluation of Normal- ity of Variables by Kolmogorov-	Variable	Test statistic(K-S)	Sig	Result
Smirnov Test	CG	0.094	0.200	The distribution of the variable is normal
	CSE	0.103	0.200	The distribution of the variable is normal
	Creativity	0.114	0.128	The distribution of the variable is normal
	AE	0.115	0.134	The distribution of the variable is normal

According to the output of the software, the value of 2χ is less than 1.198 compared to its degree of freedom, i.e. 1. The low level of this index indicates a small difference between the conceptual model and the observed research data. The value of RMSEA is equal to 0.059. The indices of GFI, NFI, IFI, RFI, and CFI are respectively equal to 0.983, 0.986, 0.987, 0.916, and 0.987, which indicate a high fit. In the following, research hypotheses were examined.

Hypothesis No. 1: CGs have a significant relationship with AE in English language learners. The results of this hypothesis are presented in Table 6:

The results of the path analysis in Fig. 2; Table 6 show that the standard coefficient between CGs and AE is 0.200, and according to the absolute value of the t-test statistic, it is 3.742 and higher than 1.96., it can be concluded with a probability of 99% that CGs have a positive and significant effect on AE (p-value=0.001; β =0.200). In other words, for an increase of one CGs unit, AE increases by 0.200 units.

Hypothesis No. 2: CSE has a significant relationship with AE in English language learners.

The results of this hypothesis are presented in Table 7:

Table 5 Correlation Study			CG	CSE	Creativity	AE
Between Research Variables	CG	Correlation	1			
		Sig. (2-tailed)				
	CSE	Correlation	0.743^{**}	1		
		Sig. (2-tailed)	0.001			
	Creativity	Correlation	0.704^{**}	0.674^{**}	1	
		Sig. (2-tailed)	0.001	0.001		
** Correlation is significant at	AE	Correlation	0.665^{**}	0.677^{**}	0.690^{**}	1
the 0.01 level (2-tailed).		Sig. (2-tailed)	0.001	0.001	0.001	
the 0.01 level (2 tunica).	-					



Fig. 1 Research model



Fig. 2 Model fit in standard estimation mode

Table 6 Examination of the Re-lationship Between CGs and AE

	Coefficient B	t-value	P-value
$CGs \rightarrow AE$	0.200	3.742	0.001
** aigmificant a	t = 0.01 larval (m < 0.0)	1)	

~~	significant	at the 0.0	i level (p<0.01)

Table 7 Examining the Rela-		Coefficient ^β	t-value	P-value
tionship Between CSE and AE	$CSE \rightarrow AE$	0.289	5.613	0.001
	**	0.01.1 1 (0.01)		

** significant at the 0.01 level (p<0.01).

The results of the path analysis in Fig. 2; Table 7 show that the standard coefficient between CSE and AE is equal to 0.289, and according to the absolute value of the t-test statistic, which is equal to 5.613 and higher than 1.96, it can be concluded with a probability of 99% that CSE has a positive and significant effect on AE (p-value=0.001; β =0.289), in other words, for an increase of one unit of CSE, AE increases by 0.289 units.

Hypothesis No. 3: Creativity has a significant relationship with AE in English language learners.

The results of this hypothesis are presented in Table 8:

The results of the path analysis in Fig. 2; Table 8 show that the standard coefficient between Creativity and AE is equal to 0.355 and according to the absolute value of the t-test statistic which is equal to 7.336 and higher than 1.96. It can be concluded with a probability of 99% that creativity has a positive and significant effect on AE (p-value=0.001; β =0.355), in other words, for an increase of one unit of creativity, AE increases by 0.355 units.

Hypothesis No. 4: CGs have a significant relationship with AE and the mediating role of creativity in English language learners.

Table 8 Examining the Rela-		Coefficient B	t-value	P-value
tionship Between Creativity	$Creativity \rightarrow AE$	0.355	7.336	0.001
unu AL	** significant at the (0.01 lowel (m < 0.01)		

** significant at the 0.01 level (p<0.01)

Table 9 Examining the Rela-		Coefficient B	<i>P</i> -
tionship Between CGs and AE			value
With the Mediating Role of Creativity Through the Boot	$CGs \rightarrow Creativity \rightarrow AE$	0.098	0.027
strap Test	** significant at the 0.05 level (p	p<0.05).	

Table 10 Examining the		Coefficient B	P-value
Relationship Between CSE and AF With the Mediating Pole of	$CSE \rightarrow Creativity \rightarrow AE$	0.074	0.028
Creativity Through the Boot-	** significant at the 0.05 level (j	p<0.05)	
strap Test			

The results of this hypothesis are presented in Table 9:

The results of the path analysis through the bootstrap test in Fig. 2; Table 9 show that the standard coefficient between CGs and AE with the mediating role of Creativity is equal to 0.098 and according to the percentage of significance, it is significant at the level of 0.05. That is, CGs have a positive and significant effect on AE with the mediating role of creativity (p-value=0.027; β =0.098). In other words, for an increase of one unit of CGs, AE with the mediating role of creativity increases by 0.098 units.

Hypothesis 5 CSE has a significant relationship with AE with the mediating role of creativity in English language learners.

The results of this hypothesis are presented in Table 10:

The results of the path analysis through the bootstrap test in Fig. 2; Table 10 show that the standardized coefficient between CSE and AE with the mediating role of creativity is equal to 0.074. According to the percentage of significance level, it is significant at the level of 0.05. That is, CSE has a positive and significant effect on AE with the mediating role of creativity (p-value=0.028; β =0.074). In other words, for an increase of one unit of CSE, AE with the mediating role of creativity increases by 0.074 units.

5 Discussion

The first research hypothesis based on "The relationship of CG variable on students' AE" shows that for the two variables of CG and AE variable, a correlation coefficient of 0.743 was obtained, which is significant at the level (α =0.05). The information obtained with the most negligible probability of error of the first type, the null hypothesis based on "no effect and relationship" is rejected, and the first hypothesis based on "the existence of a significant relationship and effect between the two variables" is concluded. It can be said with 95% confidence that there is a significant

relationship between the two variables of CG experience and the variable of AE. The explanation coefficient for this correlation coefficient also shows that with the help of the CG variable, the score of the AE variable can be explained and predicted.

The regression analysis results of predicting the variable of AE through the variable of CGs show the results of the F test for the difference between the mean of the expected and the remaining. The results of this study are supported by the results of the studies (Aghveranluei et al., 2021; Anisimov & Inshakova, 2022; Kibritchi,2007; Liu et al., 2022; Mayer et al. 1999; Mohammadjani & Safarnavadeh, 2014; Pliushch & Sorokun, 2022; Slyman, 2022; Uram & Skalski, 2022)and are completely consistent with these studies.

Kibritchi's (2007) research shows that students who taught mathematics through CGs were more advanced than students trained in the usual way. Aghveranluei et al. (2021) showed that playing these games in adolescents and young adults increases computer literacy and their perceptual skills. Pliushch & Sorokun (2022) reported that experience with the system would increase system acceptance. From this, it can be inferred that experience in any activity and with any technology, however small, can be effective for later uses and increase it. Slyman's (2022) study showed that adolescents improved their IQ, reaction time, and movement time due to playing CGs.

Uram & Skalski (2022) showed that teaching methods based on CGs effectively increase academic achievement in mathematics, motivation for progress, and attitudes toward mathematics. Anisimov & Inshakova (2022) showed that computer training technologies are practical teaching instruments to increase psychomotor skills in surgery. Young surgeons with computer technology perform better in surgery, especially laparoscopic surgery, than their peers. Therefore, paying attention to computer technologies in surgical internships can help improve the psycho-motor skills of surgeons and the interaction between them and the interface screen used in surgery. In general, it can be said that motivation, ability, and quality of education are the most important factors affecting academic success (Kidd & Crompton, 2016). When the quality of education is improved through CGs, success, and progress can increase dramatically. Also, Bloomberg has shown that using computers and video games can provide grounds for internal motivation and improve children's attention and performance (quoted by Pourroostaei Aardakani & Arefi, 2017). Therefore, CGs in education can increase attention, focus, imagination, creativity, motivation, and performance. In addition, playing these games improves critical thinking and idea production.

The results of the analysis of the second hypothesis of the study, "The relationship between CSE variable and student AE," show a correlation between the two variables of CSE and AE variable. Considering the received information, with the most probability for the first type of error, the null hypothesis based on "no relationship" is rejected. The first hypothesis is concluded based on a "significant relationship between two variables." It can be said with 95% confidence that there is a significant relationship between the two variables of CSE and the variable of AE. The regression analysis results of predicting the variable of AE through the CSE variable show that the F test was obtained for the difference between the mean of the predicted squares and the remaining. Findings of this research with the research findings of (Aldhahi et al., 2022; Akpan,2018; Bakers and Schmidt,2001; Barrett et al., 2018; Hong et al., 2022; Ozkan et al., 2014; Minott, 2021; Shaw et al., 2005; Sivandani et al., 2013; Zeto et al., 2014) are similar.

Self-efficacy is a person's beliefs about their ability to adopt selective performance levels that guide and shape the events that affect a person's life. These beliefs also affect a person's way of thinking, feeling, motivating, or behaving. A strong sense of self-efficacy improves a person's positive views and better participation in activities, goal setting, and work commitment (Saffari et al., 2014). Thus, it is clear that people with higher CSEachieve higher AE. Ball (2019) believes that when individuals have sufficient ability to use computers, they can be more effective in the teaching and learning processes Zeto et al., 2014. Akpan (2018) states that self-efficacy may be an important factor in learning computer skills (Dodge & Natividad, 2018. Researchers report that self-efficacy beliefs are positively related to academic achievement. Self-efficacy also affects learning and academic achievement. Self-efficacy affects the choice of activities, the effort expended, the endurance and perseverance in performing tasks, and the achievements of the task. Also, self-efficacy is one factor that plays a vital role in academic performance. Students with high self-efficacy achieve more progress than students with low self-efficacy (Quoted by Liu et al., 2022).

The results of the third hypothesis of the research based on "the effect of creativity variable on students' academic engagement" show there is a relationship between them. The obtained information with the probability for the first type of error, the null hypothesis of "no relationship" is rejected, and the first hypothesis of "significant relationship between two variables" is concluded. It can be said with 95% confidence that there is a significant relationship between the two variables of creativity and the variable of AE. Therefore, there is a significant relationship between the two variables. There is a positive direction. The results of the present study in this field are directly in line with the research results (Casuso-Holgado et al., 2022; Datu et al., 2022; Guilford, 2014; Fallah et al., 2022; Lu and Kaiser, 2022). As Casuso-Holgado et al. (2022) have shown in a study, highly motivated people to progress are very diligent in solving problems and achieving success. Even after failing to do something, they do not give up and strive for success (Datu et al., 2022). According to most researchers, traditional methods of education not only do not help children develop creativity but also prevent them from moving in this direction. Therefore, if as much space as possible is created and active and exploratory teaching methods are used, the creative power of individuals will flourish. Fallah et al. (2022) believe that almost everyone can be creative and that cultivating intellectual abilities is the foundation of creativity. Guilford, (2014) also found that for individuals to be creative, they must be taught the proper ways to think, in which case all people will have the ability to be creative. This study is limited to undergraduate students; therefore, the generalization of results should be made with caution.

The results of the fourth hypothesis of the research based on: Examining the relationship between CGs and AE with the mediating role of creativity through the bootstrap test.

Since CGs today can be used as a powerful tool in teaching and learning, they were not taken into consideration by experts in the field of education. CGs have many capabilities in education and learning because these games engage their users' in-game challenges and increase their creativity with instant feedback and organized

training (Tekinbas & Zimmerman, 2003; Zhang et al., 2021). The self-efficacy of CGs improves student creativity. When students design games, they are in an environment that requires cooperation, tolerance, respect for others, and sharing ideas. In other words, the self-efficacy of CGs emphasizes cooperation and group participation rather than competition between individuals (Glăveanu, 2018; Wilcox et al., 2018). Mozelius (2016), in his research, states that in the tasks that students design, implement and test digital games, at the same time as the CGs' skills and self-efficacy increase, the creativity of these students also increases. Perhaps one of the appropriate ways to cultivate creativity through CGs is the self-efficacy of CGs because there are a large number of factors that affect creativity, including increasing motivation, perseverance, responsibility, teamwork, knowledge and gaming experience and selfefficacy mentioned(Datu et al., 2022). According to researchers Zaraii Zavaraki and Gorzin, (2014), educational CGs based on the model of the learning environment have a significant effect on AE. According to Aghveranluei et al. (2021), educational computer games have a significant impact on self-directed learning and AE. Therefore, it can be said that educational CGs are effective in increasing AE, and therefore it can be said that the use of CGs is effective in increasing students' critical thinking. Therefore, the research results of these researchers are consistent with the current research, that is, there is a significant relationship between CGs and CSE and AE with the mediating role of learners' creativity.

6 Conclusion

The current study aims to determine the relationship between CGs, CSE, and creativity play an important role in AE. Therefore, it is necessary to pay attention to this in education. Our findings suggest that CG, CSE, and creativity positively and significantly affect AE. Further investigation and experimentation into AE is strongly recommended: Design and use of computer (educational) games to turn students into self-regulating individuals; Design and use of computer (educational) games to engage students with lesson concepts; Design and production of CGs or tailored to individual differences; Using CGs to help the teacher control the classroom; Using CGs to engage learning.

7 Research limitations

- 1. This study is limited to the students of the schools in terms of sample and in terms of geographical area. Therefore, the generalization of the results should be done with caution.
- 2. The impossibility of collecting accurate information from recipients.
- 3. Many disturbing variables such as the economic and social status of the learners and similar variables have been involved in this study, which the researchers have controlled as much as they could.

4. The study could not focus on the social aspects of the learners and focused more on computer experiences and academic engagement.

Limitations beyond the researcher's control

- 1. The nature of the research is quantitative, which also limits the generalization of the results faces.
- 2. Little time for conducting the research: Although it took 8 months from the design of the project and the compilation of the final research report, the researchers realized that the study on learning needs more time.

8 Suggestions based on research findings

Since some of the variances of educational progress by the variables of CSE, creativity, and computer game experience have been explained, it seems that other factors play a role in the AE of students. Therefore, it is necessary to try to find the effective causes of creativity in future studies using various methods such as focal correlation. Intelligence and motivation are among the variables that can have a high role in predicting creativity and AE.

According to the results of the study, it is suggested that classes and courses related to computers and networks be held in schools to increase their skills in the field of computers and the internet.

Considering the significant impact of CSE on creativity, it is suggested that CSE be addressed more systematically in education.

Undoubtedly, this study could not answer all the questions in the researchers' minds. Therefore, suggestions for future research are also suggested:

Studies can also focus on each of the components of the emotional field and work on them more deeply.

Studies can also focus on each of the sensory and motor areas and work on them more deeply.

Studies can be done on the effect of media literacy on the development of creative and critical learning students' self-efficacy.

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Please get in touch with the corresponding author for data requests.

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Declarations

Competing interests The authors declare that they have no competing interests.

Compliance with Ethical Standards The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. "Please get in touch with the corresponding author for data requests." cyrosizadpanah@yahoo.com.

Informed consent Written informed consent was obtained from all subjects before the study. There is no ethical or conflict of interest in this research. All the participants filled out consent forms.

Ethics approval Our intervention was educational and did not have clinical manipulation on humans.

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