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Relation Between Math Anxiety and Playing Computer Games: Students Perceptions

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Abstract: Mathematics is seen as the most frustrating subject and has the highest failure rate, and is the subject that students tend to fear the most, and this anxiety turns into a math phobia. Due to the complexity of mathematics, some students are anxious about learning it. Therefore, the objective of this paper was to analyze the relationship of playing computer games to the level of mathematical anxiety in students. The methodology chosen for this study is a correlational research design. The selected sample was represented by 76 students from the music high school "Lorenc Antoni" and the lower school "Heronjtë e Lumës" Prizren from Kosovo. A questionnaire with two sections was used for data collection, where the first section measures the level of students' anxiety about mathematics and the second section measures students' liking for computer games. The results from this research show that there is a correlation between students' anxiety about mathematics and playing computer games, and vice versa. Consequently, it is argued from students' perceptions that their mathematics anxiety is likely to affect the learning environment by playing computer games.

Keywords: Anxiety, Computer Games, Learning, Math, Playing, Students

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1. Introduction

It is now necessary to pursue alternative teaching methods that allow students to learn mathematics in a calm and unhurried setting without having to worry about failing or losing their self-respect. Every math student needs to learn that failure is a necessary step on the road to success and shouldn't be something to be afraid of or ashamed of. A crucial first step in creating a positive learning environment is to make mathematics for students a visually appealing, captivating, and immersive subject. It is necessary to change mathematics from a subject that is only learned by memorizing facts to one that involves imagination and creativity. For students to gain confidence and fall in love with the subject, teachers must emphasize the value of original and qualitative thinking throughout the learning process.

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Children who experience math anxiety may experience physical and psychological symptoms like heart palpitations and mental health issues. Additionally, because of the poor outcomes, students may perform poorly on assessments and tests at school. It's crucial to transform your fear of math into confidence because math is a foundational subject for many other disciplines, including science and international affairs. Additionally, a student's self-esteem and lifelong math abilities depend on this transformation. The purpose of this study is to take advantage of computer games' potential to reduce anxiety and boost confidence. Computer games demonstrate to a student that their skills can be developed through commitment and effort, which fosters a growth mindset. Students see opportunities for growth rather than challenges as factors that increase the likelihood of failure. Students may be reluctant to participate in class when they fear the social repercussions of answering a math question incorrectly. Because they don't feel connected to the subject, they may find it difficult to fully concentrate in class as a result.

Therefore, "a crippling negative emotional response to math" is the definition of math anxiety (Hill, Mammarella, Devine, & Caviola, 2016). Math anxiety is a multifaceted concept that encompasses anxiety about math tests, anxiety about learning math, and anxiety about using math in real-world situations (Cipora, Santos, Kucian, & Dowker, 2022). Indeed, numerous studies have shown that game-based learning is effective in the teaching of mathematics (Byun, 2018). As a result, Deficit Theory suggests that games may help people feel less anxious about math by improving their math abilities. Playing educational games can support students' critical thinking, problem-solving, and understanding of abstract math concepts (Plass, Mayer, & Homer, 2020). Since one's belief or expectation of successfully completing specific tasks or achieving specific objectives is known as self-efficacy (Bandura, 1988), It is believed that using computer and information technologies to practice and provide immediate feedback can help students learn mathematics more effectively.

On the other hand, educators have understood the value of utilizing the educational potential of video games for a long time. Teachers can lower students' math anxiety and promote math as a fun and challenging exercise by incorporating online puzzles and competitive computer games into assignments and activities. Students may feel much more confident and comfortable engaging privately in computer games, where the social consequences of making a mistake are much less acute.

1.1.**Identification of the problem**

In recent years, anxiety about the prospect of learning mathematics has been recognized as an important factor shaping mathematics learning, mathematics performance, and basic numerical skills of adults in the classroom (Maloney, Risko, Ansari, & Fugelsang, 2010). Achievement in mathematics is inversely correlated with mathematics anxiety.

Anxiety in math has been linked to negative attitudes toward the subject as well as poor results in math performance and self-confidence in one's ability to learn the subject (Bekdemir, 2010). Poor math performance may result from math anxiety because it strains working memory and prevents it from being used to its full potential when performing math-related tasks. Math anxiety can also lead to poor performance because those who struggle with it often avoid math-related tasks or complete them in a hurried, inaccurate manner in an effort to escape the stressful situation (Ashcraft & Krause, 2007).

1.2.**Purpose of Study**

Mathematical ability is frequently used as a filter when choosing career paths because it is a crucial subject in education and career preparation. A cognitively demanding subject,

mathematics requires the manipulation of symbols in a setting that is frequently very abstract. In contrast to language, which kids pick up naturally from their surroundings early in life, mathematics should be taught in schools. Given that different points in the mathematics curriculum may be specified depending on the grade level at which computer games may be introduced, this should provide cognitive psychology with some advantages in the study of mathematics.

As a result, the goal of this study is also derived using the students' anxiety toward mathematics and the inclusion of computer games in the learning of this subject. The goal of this essay is to present students' perspectives on the connection between playing computer games and their levels of anxiety about mathematics-related topics. The factors we need to examine are cooperative play, adaptability, social interactions, introducing real-time measurements of math anxiety into the game, and features that promote intrinsic motivation. We searched for randomized studies describing computer game-based interventions to reduce math anxiety.

1.3. **Research Questions**

The main questions of this research are as follows:

1. Does the level of anxiety about mathematics among students vary according to gender, age, class or level of knowledge about this subject?
2. What are the students' perceptions of the level of anxiety about the subject of mathematics and playing computer games?
3. Is there any relation of game-based mathematics learning approach to students' mathematics anxiety?
4. Do we have any statistically significant regression according to students' perception that the more we play computer games, the more the phobia for the subject of mathematics will go away?

2. **Literature review**

When new concepts are introduced as a logical learning progression, games also meet the specific teaching and learning needs of students. Learning progressions, or the order in which these skills are typically developed, are frequently described as the route students take to learn a body of knowledge or set of skills. In education, learning progressions are frequently used. In conventional classroom settings, a student may be left with a gap in his knowledge base that makes it difficult for him to later attempt to build more complex concepts. In contrast, computer games compel players to understand a concept in order to advance (for instance, double-line jumping while in mid-air to cross a lava pit). Players can practice the same scenario over and over until they understand it. The use of video games in the classroom can follow the same principles. In essence, a learner cannot solve algebra problems until they have acquired the necessary background knowledge. Students might have to spend a lot of time learning each skill before moving on to the next with this mastery-based learning, though. These scenarios imply that a student has some curricular control and choice. The learner's sense of agency and autonomy is crucial. The failure to give the learner an appropriate level of action is the most frequent error in online learning activities. Action is the learner's capacity to engage with the subject matter, as well as their sense of social and emotional support. According to Dalton (2000), 56% of online course participants reported feeling a lack of interaction and choosing not to be active learners. However, well-designed games inspire students to customize and create the teaching and learning methods that work best for them, which promotes a greater level of involvement in the learning process (Klopfer, Osterweil, & Salen, 2009).

Additionally, lowering math anxiety can help students feel more confident in their ability to learn the subject, which will boost their learning efficacy. Therefore, coming up with new teaching methods or tools to ease students' math anxiety and increase their confidence is a crucial and difficult task (Peters, 2013).

To illustrate how students, when engaged in creative activities they consider fun, are unaware that they are also developing mathematical concepts, Papert related an incident from his observations of children playing LOGO. He described how a fifth-grader who claimed to "hate math" actually demonstrated aptitude for computer programming. It took the student a full year to realize that she was carrying out mathematical operations and creating mathematical concepts while she was programming. This incident showed Papert how using the LOGO environment changed a student's misconceptions about mathematics, sense of self-motivation, and ability to perform mathematical actions (Abrams, 2006).

Based on encouraging data gathered in closely related research fields, play-based learning has been proposed as a potential treatment for math anxiety over the past ten years. The term "game-based learning" describes the practice of using video games to encourage learning. These games are frequently referred to as educational or serious games. By incorporating elements like clear, relevant personal goals, serious games can present educational material in a more interesting way than traditional classroom instruction. According to Juul (2010), a game is “a formal rule-based system with a variable and measurable outcome, where different outcomes are assigned different values, the player makes efforts to influence the outcome, the player feels connected to the result, and the consequences of the activity are optional and negotiable" (Juul, 2012).

In a recent study, Pareto et al. (2011) developed a learnable agent math game to hone fundamental math abilities. A study involving 153 participants, mostly third- and fifth-graders, evaluated the game. The outcomes demonstrate how the game enhanced students' mathematical proficiency and sense of self-efficacy. The creation of a fractions-related educational mathematical game for elementary school students is described by Ahmad and Latih (2010). Similar to this, Lee (2009) discusses the development and assessment of a fractions educational game and notes that it enhanced students' comprehension and performance. More specifically, video games foster active learning and the growth of a variety of skills while retaining their appealing and enjoyable aspects (Pareto, Arvemo, Dahl, Haake, & Gulz, 2011; Ahmad & Latih, 2010).

It can be hypothesized that students are naturally drawn to computer games because they are entertaining based on how computer games increase the speed and focus of learning mathematics (Demirbileka & Tamer, 2010). According to a study, digital game-based learning (DGBL) that gives students feedback helps them learn while also lowering their math anxiety. These games reduce the anxiety associated with learning and create a fun learning environment that boosts both motivation and learning (Huang, Huang, & Wu, 2013).

Çankaya and Karamete (2009) studied the effect of educational computer games on students' attitudes toward mathematics and reported a positive attitude as a learning achievement. Demirbileka and Tamer (2010) conducted a qualitative study and interviewed thirteen mathematics teachers in Turkey in order to develop a theoretical framework for the use of educational computer games in teaching mathematics. They came to the conclusion that computer games significantly improve students' academic success. Grimley et al. (2011) investigated the impact of computer games on learning performance in comparison to the presentation method and came to the conclusion that students who receive training in the use of computer games have higher emotional intelligence and readiness, are more engaged,

participate more, and develop a sense of competition (Çankaya & Karamete, 2009; Demirbileka & Tamer, 2010; Grimley, Green, Nilsen, Thompson, & Tomes, 2011).

Math anxiety or phobia causes students to score 34 points lower on math tests than students who do not have it, according to research from the Program for International Student Assessment (PISA). A full school year is lost as a result of this anxiety. These findings demonstrate a direct relationship between math anxiety and phobia and low academic achievement, indicating that overcoming math anxiety can significantly enhance student performance (Nath, 2021).

There are numerous ways to implement game design principles in the classroom. Computer games are digital simulations of real-world events that are played for the purpose of problem-solving (Connolly, Boyle, Macarthur, Hainey, & Boyle, 2012). For instance, students were able to independently explore their learning environments while playing the science research game River City. To address the issue, they developed their theories and ran their experiments (Klopfer, Osterweil, & Salen, 2009).

In general, well-designed games are difficult but doable, just like well-designed educational experiences. To increase player engagement, challenges in games should be scaled to the player's skill level. The key is to set the task's difficulty level so that the student has to exert some effort but still manages to finish it with only moderate assistance. This is comparable to Vygotsky's zone of proximal development, which is defined as "the gap between the level of potential development as determined by problem-solving under adult guidance, or in collaboration with the most capable colleagues," and the actual level of development as determined by independent problem solving (Vygotsky, 2006).

A crucial skill for the twenty-first century is conceptual thinking. By enabling players to see the effects of their actions, multiplayer role-playing games can also support problem-based learning. They could play much more quickly than they could in real-time, putting them in situations rather than just reading about them. Gee (2007) asserts that high-quality immersive games require players to think methodically and take relationships into account rather than singular events or facts. Games' abundance of options and possible decision-making opportunities compel players to apply and adapt their knowledge to various contexts. Because they are playing in an abstract way, they must think abstractly. This fosters the growth of their capacity for innovation, problem-solving, and decision-making (Johnson, Smith, Willis, Levine, & Haywood, 2011).

More recently, a collaborative project called Electronic Games for Mathematics and Science Education (EGEMS) looked into the development and application of computer games to improve mathematics learning, specifically for students between the ages of 9 and 14. A priority was given to developing educational computer game prototypes and carrying out targeted quantitative and qualitative studies to assess the efficacy of various design and usage options. According to the project's findings, children who actively "think about and evaluate the mathematics embedded in the computer game with three factors that are particularly important in focusing students' attention in mathematics: teachers' attitudes, support activities, and cooperative play" can learn and enjoy mathematics more while playing computer games (Mor, Winters, Cerulli, & Björk, 2006).

3. Method of the Study

3.1.Design of Study

The present study aims to understand the relationship between computer games based on the principles of learning mathematics and anxiety levels for this subject. Therefore, the methodology used for this study is the correlation method. A correlational research design investigates relationships between variables without the researcher controlling or manipulating any of them. A correlation reflects the strength and/or direction of the relationship between two (or more) variables. The direction of a correlation can be positive or negative (Bhandari, 2021). The choice of this design will give some information about whether there is any relationship between math anxiety and computer games. The choice of this design will give some information about whether there is any relationship between math anxiety and computer games.

3.2.Participation

The sample of the study consists of 76 students from the music high school "Lorenc Antoni" and the lower school "Heronjtë e Lumës" in Prizren from Kosovo. The selected sample is purposive since the participants are students that I work as a teacher in those schools and this study was conducted to understand their mathematics anxiety. Of them, 32 were female and 44 were males, also 25 students were 12 years old, 9 students were 13 years old, 7 students were 14 years old, 12 students were 15 years old, 14 students were 16 years old, 7 students were 17 years old, and 2 students were 18 years old. So, the study sample includes groups and schools by choosing a sample based on gender, age, and different classes to carry out this study.

3.3.Data Collection and Analysis

In order to identify whether computer games have any relationship of anxiety levels in mathematics, a statistical analysis was performed to compare students' perceptions from the questionnaire. Therefore, the data collection instrument for this research was a questionnaire with closed questions, with two sections. The questionnaire questions were compiled by the researcher himself and the answers are on a 5-point Likert scale, from never to always. This questionnaire helped us to measure the variables of interest, where the survey was conducted online. The survey was a quick and flexible way to collect standardized data from many students, but it is important to ensure the questions are formulated in an unbiased way and capture relevant knowledge. The first section included 15 questions about the levels of anxiety for the subject of mathematics, which includes the questions that the students are afraid of making mistakes while solving the task on the table and that their friends will make fun of them, to the questions that they are afraid that the teacher will call by name to solve the task. And, the second section was about 15 questions related to playing computer games, which includes questions about how students enjoy playing mathematical computer games and questions about whether students think they will play them in the future mathematical computer games. After collecting the data, these questions were statistically analyzed for relationships between variables using regression analysis. Whereas, with a regression analysis, we have tried to predict how much a change in one variable will be associated with a change in the other variable. The result is a regression equation that describes the line on a graph of the variables. The reliability of the questionnaire was performed using the internal consistency with Cronbach's alpha coefficient index, as a function of the number of questionnaire questions and the average correlation between the questions. From our results, Cronbach's alpha coefficient was .901,

indicating that the questions have relatively high internal consistency. Also, to evaluate the validity of the questionnaire we used the KMO test, where the results from the Kaiser-Meyer-Olkin Measure of Sampling Adequacy test was .718 and we have the significant with .000, which shows that the questions have good validity among anxiety questions for mathematics and playing mathematical computer games.

4. Findings

The survey achieved a high response rate, with the average level of students' math anxiety at 2.59 and a standard deviation of .734. This shows that students on average had mathematics anxiety. Taking gender as a basis, we see that there is no statistically significant difference in students' anxiety about mathematics since the results show that the average for both male and female gender reaches the average value of 2.59. So, both women and men have the same anxiety about math. The results of the survey showed that math anxiety seems to bother both genders, thus justifying the need to find different ways to overcome this anxiety. Math anxiety varied by age, with 12-year-old students having an average anxiety of 2.72, 13-year-old students having an average anxiety of 2.78, 14-year-old students having an average anxiety of 3.14, 15-year-old students having an average anxiety of with 2.42, 16-year-old students had an average anxiety of 2.14, 17-year-old students had an average anxiety of 2.57, and 18-year-old students had an average anxiety of 2.50. The results of the study show that students up to the age of 14 had the highest level of mathematics anxiety, while anxiety significantly decreases after the age of 15. Also, analyzing math anxiety according to classes, we have resulted that sixth-grade students had an average of 2.92 anxiety, seventh-grade students had an average of 2.64 anxiety, eighth-grade students had an average of 2.67 anxiety, ninth-grade students had an average of 3.0 anxiety, tenth graders averaged 1.9 anxiety, eleventh graders averaged 2.47 anxiety, and twelfth graders averaged 1.0 anxiety. From these results, we are noticing that lower secondary school students have more anxiety compared to upper secondary school students. On the other hand, comparing the students according to their level of knowledge of mathematics, we notice that students who have an insufficient grade in mathematics have an average of 4.0 anxiety for mathematics, students who have a sufficient grade in mathematics have an average of 2.78 anxiety for mathematics, students who have a good grade in math have an average of 2.93 math anxiety, students who have a very good grade in math have an average of 2.52 math anxiety, and students who have an excellent grade in math have an average of 2.1 math anxiety. From these results, we are noticing that the students who are weaker in mathematics have the highest level of anxiety about mathematics and vice versa.

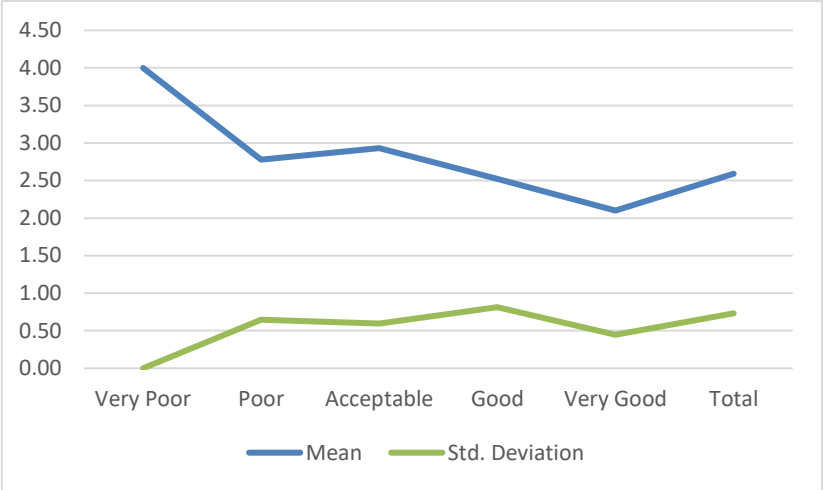

Diagram 1. Results of the level of anxiety about the level of knowledge of mathematics

To understand that students have mathematics anxiety, we addressed them with some questions. Our results from 76 participants show that about half of them have asked for permission from the teacher in math classes and have anxiety when faced with a math problem. A quarter of the number of students declares that they have doubts about the result and think that they got the task wrong, while more than half of the students declare that they have pressure in doing homework, have a negative previous experience with mathematics, and have learned a lot about math tests, but have low success. Also, about half of the students declared that they had limited time in math tests, had difficulty remembering previous math concepts, and a very important result was that they were afraid of making mistakes while solving the task on the table, and friends make fun of him. However, students do not claim to have torn notebooks and books intentionally during mathematical activities in the classroom. But many students declare that they had teachers who made math boring and they are afraid that the teacher will call them by name to solve the task. However, about a quarter of the number of students thinks that they have fatigue and stress when they solve any mathematical problem and that you do not need these mathematical tasks that are taught, while the rest think the opposite. So, from our study results, we are seeing that more than half of the students believe that they are not good at mathematics. Therefore, we are giving the summarized results for students' anxiety about mathematics in the table below:

Table 1. Summary results for students' mathematics anxiety

	N	Minimum	Maximum	Mean	Std. Deviation
Anxiety in math	76	1	4	2.59	,734
Valid N (listwise)	76				

Analyzing the results of table 1, we observe a mean of 2.59 and a standard deviation of .734, which shows that more than half of the students had mathematics anxiety. From this, we can say that many factors can contribute to math anxiety. These factors according to our results include teachers, methodology, classmates, and society. Negative experiences of learning math in the classroom can lead to increased math anxiety.

On the other hand, in order to reduce anxiety towards mathematics, we tried to see the impact of playing computer games on the level of students' anxiety about topics from the subject of mathematics. The results of the study show that participating male students play more mathematical computer games compared to female students. From this, it is understandable that boys play computer games more than girls. Comparing by age, 12-year-old students like math games the most, followed by 13-, 15-, and 16-year-old students. This shows that students up to the age of 16 like to have fun with computer games. However, the results probably show that high school students have positive perceptions of mathematical computer games, at the same time as low school students. On the other hand, looking at the results of our study, we are noticing that students' mathematical knowledge is resulting in a relationship with computer games, since our results are showing that students who have good knowledge of mathematics are eager to play computer games. So, our results show that about 72.4% of students have played mathematical computer games, about 68.5% of students enjoy playing mathematical computer games, about 60.5% of students stated that they learned by playing mathematical games, about 68.5% of students stated that they have motivation for passing the levels of the mathematical computer game, about 65.7% of the students declared that they gained knowledge during computer games in solving mathematical problems, about 71.1% of the students declared that they strengthened their calculation skills by playing computer games, about 64.5% of students stated that they developed critical thinking by playing mathematical computer games, about 61.9% of students stated that they learned to solve real-world problems through computer game activities, about 64.5% of students stated that they applied game practice in solving mathematical problems, about 67.1% of students d declared that they stayed engaged in mathematics after playing computer games, about 57.9% of students declared that they gained self-confidence after playing computer games against friends while solving mathematical tasks, about 68.5% of students declared that they have a higher focus on mathematics lessons after playing computer games, about 57.8% of students declared that they noticed significant changes in mathematics lessons after integrating computer games into the learning process, about 60.5% of students declared that they changed their attitude towards mathematics after playing computer games, and about 67.1% of students declared that they think they will play mathematical computer games in the future. Therefore, the summarized results for playing mathematical computer games are given in the table below:

Table 2. Summary results for playing mathematical computer games

	N	Minimum	Maximum	Mean	Std. Deviation
Computer games	76	1	5	3.00	,993
Valid N (listwise)	76				

According to the results of table 2 we are noticing that we have a mean of 3.00 and a standard deviation of .963 which shows that the students have a pretty high satisfaction with playing mathematical computer games. In other words, playing computer games promises to diversify mathematics, increase students' interest and motivation, and provide positive and effective learning experiences.

The results from the study show that the significance is significant at the .05 error level. At 95 percent confidence, the result showed a positive correlation between math anxiety and playing math computer games (r= .220, p< .05). This result shows that we have a weak positive correlation, but nevertheless we can say that the perceptions of students show that those who had high anxiety in mathematics can be reduced a little bit by playing mathematical computer games.

To understand the mathematical relationship between the independent variable of students' anxiety about mathematics and the dependent variable of playing computer games we analyzed through the linear regression coefficient. The results of the linear regression are described as follows:

Table 3. Summary of the linear regression model for anxiety and computer games

Pattern	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,220 a	,048	,035	,720

a. Predictors: (Constant), Computer games

As can be seen from the results of table 3, we notice that we have a regression with a value of .220, which indicates a weak degree of correlation. From the R^2 value, it is shown that the relationship of anxiety for mathematics through playing computer games has only 4.8% impact on students.

Other results were analyzed with ANOVA, which reports how well the regression equation fits the data. The results are shown below:

Table 4. ANOVA regression results for anxiety and computer games

	Pattern	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,946	1	1,946	3,749	,047 b
	Residual	38,409	74	,519		
	Total	40,355	75			

a. Dependent Variable: Anxiety in math
b. Predictors: (Constant), Computer games

The results of table 4 show that the regression model predicts the dependent variable of students' math anxiety very well. This shows the statistical significance of the regression model that was run and the value p is .047 which is less than .05, and shows that, overall, the regression model statistically significantly predicts the outcome variable.

The table of coefficients provides us with the necessary information to predict computer games, as well as to determine whether computer games contribute statistically to the reduction of students' anxiety about the subject of mathematics. Furthermore, we are presenting the results of the coefficients as follows:

Table 5. Results of the coefficients for anxiety and computer games

Pattern		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2,106	,264		7,961	,000
	Computer games	,162	,084	,220	1,936	,047

a. Dependent Variable: Anxiety in math

The results of table 5 show that the average score of anxiety is 2.106 when the number of playing computer games is equal to zero. The unstandardized coefficient B of .162 tells us the average change in the response variable is associated with a one-unit increase in the predictor variable. In this study, each additional computer game played was associated with a .162 ratio of student math anxiety. In this case, since the value p is less than .05, we can conclude that the predictor variable of computer games is statistically significant.

Finally, we can form a regression equation using values for constants and computer games. In this case, the equation would be:

$$Relationship\ between\ anxiety\ and\ computer\ games\ score = 2.106 + 0.162 \cdot (game)$$

We can use this equation to find the estimated math anxiety score for a student, based on the number of games played. For example, a student who plays for 3 computer games is expected to affect math anxiety by 2.592 percent.

$$Relationship\ between\ anxiety\ and\ computer\ games\ score = 2.106 + 0.162 \cdot 3$$
$$= 2.592$$

5. Conclusion and Discussion

The gamified aspect of computer games encourages students to learn mathematics and boosts their engagement and confidence, which creates favorable perceptions of the subject. Therefore, the purpose of this essay was to examine how computer game playing affects students' levels of mathematical anxiety.

Our results show that there were significantly fewer upper secondary school students than lower secondary school students reporting mathematics as their favorite subjects. However, our findings show that lower high school students had more math anxiety compared to high school students. In terms of age, the presentation of anxiety about mathematics was up to the age of 14. Our findings reflect that negative attitudes towards the subject of mathematics can cause disruptions in students' learning and further discourage them from performing well in the subject. Our study provides new empirical evidence that a treatment consisting of mathematical computer games has a relationship with students' levels of mathematics anxiety.

Anxiety about mathematics in this study was related to several factors: such as teachers' influence, teaching method, perception of mathematics difficulty, pressure of time constraints

on tests, fear of being ridiculed by peers, and belief that mathematics performance is a measure of intelligence. On the other hand, showing that, regardless of the teaching method, students' performance, beliefs, attitudes and anxiety influence each other, so that according to our correlational results, those with less anxiety can achieve better results and vice versa.

Our results show that there was a weak positive correlation between students' level of mathematics anxiety and playing computer games. Also, a regression was presented which was statistically significant and that the level of anxiety about mathematics through playing computer games has an impact of only 4.8% on students.

To answer the first question of the research, whether the level of anxiety about mathematics among students varies according to gender, age, class or level of knowledge about this subject, we are basing ourselves on the results of the study. Taking gender as a basis, we see that there is no statistically significant difference for students' anxiety about mathematics. The results of the study show that students up to the age of 14 had the highest level of anxiety about mathematics, while anxiety significantly decreases after the age of 15. From the results, we are noticing that lower secondary school students have more anxiety compared to upper secondary school students. On the other hand, looking at the results of our study, we are noticing that students' mathematical knowledge is resulting in a relationship with computer games.

However, to answer the second question of the research, what are the students' perceptions of the level of anxiety about the subject of mathematics and playing computer games, we are basing it on the results of the regression coefficient with the equation presented in the results. Also, based on student responses, they claim that math confidence, math value, and math barriers are related to math behavior and performance. Therefore, this study reported that students with low math confidence or high math anxiety can benefit from playing math computer games.

To answer the third question of the research, whether is there any relation of game-based mathematics learning approach to students' mathematics anxiety, we are based on the results of table 2, where it is showed that students with a high average outlined the approach to develop contemporary teaching methods that can be applied to students or the curriculum of the subject to help reduce their anxiety about mathematics. This approach in this study evaluated computer game-based learning as an active learning technique that uses games to influence students' level of mathematics anxiety.

The fourth research question was whether there is any statistically significant regression that the more we play computer games, the more the math phobia will go away. To answer the research question, we are basing ourselves on the results of the research, which show that the significant significance is .047, which shows that this correlation exists and that it reaches the value of .220. It is perhaps understandable that this anxiety could not be expected to be completely overcome, but somehow mathematical computer games are associated with students' phobia of lower-level mathematics that compromises the development of higher-level mathematical skills. Also, in the results of the linear regression tables, it is shown that this regression was statistically significant and has a value of .220. Thus, each additional computer game played is associated with a .162 reduction in students' math anxiety. In other words, the

students' perceptions show that if the student plays 3 mathematical computer games, it will have an impact on reducing his performance in this subject by 2.6%.

In addition, the implemented measures can also be used to explain the degree of students' anxiety regarding mathematics. We can draw the conclusion that playing computer games has a somewhat efficient relationship for the level of students' anxiety about mathematics in order to draw differentiated conclusions about the influence of computer games in the intervention of anxiety reactions related to mathematics and/or math phobia.

Computer games proved in this study to be an attractive distraction for students suffering from mathematics anxiety. The level of students' anxiety about the subject of mathematics, as well as the promotion of their self-efficacy in mathematics, learning motivation and learning achievement has been recognized as a challenging and important issue. This study provides additional proof that playing computer games and doing math problems can help reduce math anxiety. Additionally, this study has supported the idea that students may feel more positively about mathematics if they play computer games in class.

These correlations mean, simply but more importantly, that the level of math anxiety, math achievement declines. This seemingly inherent relationship between anxiety and math achievement poses a real interpretive dilemma. Critically, the reduction in students' anxiety about the mathematics subject was particularly prominent among students suffering from high levels of math anxiety. These findings have shown that students' anxiety about the subject of mathematics has decisive effects on learning. Fortunately, the results of our study according to the perception of students showed that this problem can be significantly reduced by playing computer games in the learning process. Our study thus emphasizes the special potential of this strategy for improving mathematics teaching in educational practice. The objective of the current study is to comprehensively review the body of research on interventions and strategies for lowering math anxiety in students by using computer games.

In the end, it is still difficult to determine exactly how computer games can help students who are experiencing math anxiety. This study still offers insightful information about the state of computer game research in relation to student anxiety levels, though. The results of this study suggest potential benefits that may provide guidance for future research and the creation of successful interventions aimed at lowering students' anxiety about mathematics.

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