Multidisciplinary Journal for Education, Social and Technological Sciences

https://doi.org/10.4995/muse.2020.12622
ISSN: 2341-2593

The Effects of Active Recreational Maths Games on Maths Anxiety and Performance in Primary School Children: An Experimental Study

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Received: 02 November 2019; Accepted: 08 March 2020; Published: April 2020

Abstract

This study investigates the effect of active recreational maths games (ARMG) on 1st grade male students' maths anxiety and performance. The sample was divided into two groups: an experimental group (N=28), which was taught maths with ARMG in addition to traditional teaching methods, and a control group (N=30), which was taught with traditional teaching methods only. The ARMG consisted of 24 sessions taking place over a period of two months. Students participated in three sessions per week, each of which lasted 45 minutes. The findings revealed a significant negative correlation ($r=-0.482$; $p<0.05$) between maths anxiety and students' performance. A significant difference ($\alpha= 0.05$) in maths anxiety and performance emerged between the experimental and control groups. The experimental group obtained lower maths anxiety scores and higher performance scores than the control group. Considering these results, the study proposes several recommendations and suggestions to develop maths teaching with ARMG.

Keywords: Recreation games, Maths anxiety; Maths performance; Primary school; Teaching strategy.

Multidisciplinary Journal for Education, Social and Technological Sciences
https://doi.org/10.4995/muse.2020.12622
ISSN: 2341-2593

1. Introduction

The twenty-first century teacher must impart knowledge to students, but also develop successful teaching strategies to facilitate the learning process (Johnson, 2013). In the past decades, educators have been increasingly aware of the necessity of examining which teaching strategies are the most effective (Eady & Lockyer, 2013; Johnson, 2013). Educators identify different learning methods to assist them in creating and developing the right strategies to deal with their target groups and realizing their educational objectives by imparting relevant knowledge and skills, and the necessary positive attitudes towards learning (Arthur et al., 2017; Kelly & Pohl, 2018).

According to Harris (2000), a "[t]eaching strategy is a generalized plan for a lesson or lessons which includes structure, desired learner behavior in terms of goals of instructions and an outline of planned tactics necessary to implement the strategy" (p. 12). Teaching strategies refer to methods, techniques, procedures and processes used by a teacher to help students learn the desired course content and develop achievable goals in the future (Tiwari, Rathar, & Singh, 2007).

Primary education is the first phase of compulsory education in many countries and the starting point of the education system (Alharbi & Madhesh, 2018). Educators have indicated that one of the most essential academic periods is the primary stage, for much of the cognitive, social, emotional, cultural and physical skills, alongside the personality and general development of a child, takes place during this period (Rosalind, 2011). Beliefs, values, and feelings, either positive or negative, towards school and different subjects are often formed in primary school (Hacieminoglu, 2016; Anggoro, 2017). For this reason, most advanced countries have directed special efforts toward the development of primary education (Rosalind, 2011).

Maths is an essential subject of the school curriculum and is important in daily living (Yüksel-Şahin, 2008). Moreover, it is an instrument for the development of all other sciences (Divjak & Tomic, 2011). However, there is a common belief that the majority of students dislike maths due to its very nature (Luttenberger, Wimmer, & Paechter, 2018). More specifically, Geist (2010) has reviewed a number of psychological studies and concluded that maths anxiety was the main factor for the aversion of maths. Psychological explanations suggest that maths anxiety stems from weaknesses in the curriculum, negative experiences with maths, pressure and family expectation, peer pressure, teaching styles, and learning environments (Geist, 2010; Luttenberger et al., 2018).

This study investigates the effectiveness and positive outcomes of active recreation on maths anxiety and students' performance. To achieve this, the study seeks to fulfill two objectives:

- To find out whether maths anxiety influences students' performance.
- To examine the difference between the maths anxiety and performance scores of the control group who used traditional teaching instruction (TTI) and the experimental group who used traditional teaching instruction supported by active recreational maths game (ARMG).

Results of the study will help students, teachers, counselors, and parents gain greater insight into how to avoid the negative effects of anxiety in maths instruction. In addition, the study assists instructional and recreational game designers by creating information about the required game components to reduce maths anxiety, optimize academic performance and avoid negative effect on future career choice. Moreover, it offers a novel comparison between results obtained in Saudi Arabia, a developing country, and results from foreign studies.

2. Literature Review

Maths anxiety is commonly defined as "a feeling of tension, apprehension, or fear that interferes with maths performance" (Ashcraft, 2002, p.181). More recently, Lorenzen (2017) described maths anxiety as a state of discomfort that one experiences when involved in situations requiring the use of mathematics and that can affect people of all ages. Therefore, it can be regarded as negative psychological reactions involving fear, apprehension, low confidence, and tension towards any activities related to maths skills or numerical manipulations (Luttenberger et al., 2018). Maths anxiety has been a concern for researchers because of its proven negative effect on students' performance (Wu, Barth, Amin, Malcarne, & Menon, 2012; Siebers, 2015; Puteh & Khalin, 2016). Geist (2010) and Luttenberger et al. (2018) have found evidence that maths anxiety may cause low performance because children with high maths anxiety tend to avoid maths-related tasks.

https://doi.org/10.4995/muse.2020.12622
ISSN: 2341-2593

Understanding maths anxiety during childhood is most important. Studies have found that maths anxiety increased with age among 1st to 6th grade school children with ages ranging from 7 to 12 years old (Wood et al., 2012). Furthermore, preventing a growing negative attitude towards maths is especially crucial considering that it has been shown to affect the child in the long term and into adulthood (Kendall, Safford, Flannery-Schroeder, & Webb, 2004; Scarpello, 2007; Dunn & Goodyer, 2006; Siebald, Khandaker, Zammit, Lewis, & Jones, 2016). Maths anxiety in childhood also affect career choices. Scarpello (2007) has found that seventy-five percent of Americans stop studying maths and avoid careers that related to mathematics due to childhood maths anxiety. Espino, Pereda, Recon, Perculeza, and Umali (2017) reached the same conclusion in relation to students in the Philippines. They found that maths anxiety has a significant effect on further studies and career choice of grade 11 students. Because of maths anxiety, most of the respondents tended to pursue humanities and social sciences in their education. Hence, Furner and Gonzalez-DeHass (2011, p. 226) stressed that “Maths anxiety is a real issue that can impact a child goals, many career-related decisions they may make in life and their overall future”.

Therefore, researchers have focused on developing effective teaching tools to improve students’ academic performance in maths to offer alternatives to traditional teaching strategies. There is solid evidence that enjoyment is one of the most important components of effective teaching (Zosh et al., 2017; Liu et al., 2017). Games, for instance, will facilitate the learning process and satisfy most educational needs in childhood (Zosh et al, 2017). Therefore, studies have tested strategies to make the learning process more enjoyable, such as computer and video games, to improve students’ maths performance (Sayan, 2015; Hieftje, Tyra, Kyriakides, Gilliam, & Fiellin, 2017; Chizary & Farhangi, 2017). With such games, children can learn graphs, charts, shapes, colors, as well as gain positive values and experiences (Liu, 2017).

According to Hurd and Anderson (2011), recreation is defined as an activity that individuals engage in to satisfy their needs for excitement, fun, amusement, and enjoyment. Recreational activities can be broadly categorized as passive or active. Passive recreation refers to non-motorized activities for which a person does not exert any significant physical energy (e.g. going to the cinema, watching television, playing computer and video games). Active recreation refers to activities that require physical exertion (e.g. sports, walking, dancing, playing on a playground or any enjoyable physical activity (Hurd & Anderson, 2011; Salmon et al., 2019).

The general consensus is that passive recreation (e.g. television and video games) is negatively correlated with well-being, while physically active recreation activities positively contribute to the psychological well-being of children (Holder, Coleman, & Sehn, 2009; Eime, Young, Harvey, Charity, & Payne, 2013; Çetinkaya, Sahin, & Yariz, 2017; Laidley & Conley, 2018; Salmon et al., 2019). They can enhance self-efficacy and self-esteem (Nieman, 2002), self-concept and self-confidence (Scully, Kremer, Meade, Graham, & Dudgeon,1998), provide opportunities for more positive social interactions (Eime et al., 2013), and reduce depression, anxiety, and symptoms related to attention deficit disorders (Biddle & Asare, 2011; Goldstein, 2012; Paggi, Jopp, & Hertzog, 2016).

Generally, the desire to progress in the game, improve the way of playing and win are constructive and educational aspects of games (Cagiltay, Ozcelik, Ozcelik, 2015). They motivate passive students to think (Burguillo, 2010; Cagiltay et al., 2015). Findings of empirical studies revealed that a combination of game playing and friendly competitions resulted in strong motivation and increased learning effectiveness (Burguillo, 2010; Divjak & Tomic, 2011; Cagiltay et al., 2015). Researchers suggest that a successful computer game must meet pedagogical criteria and be exciting in order to have a positive effect on students (Kebritchi, Hirumi, & Bai, 2010; Divjak & Tomic, 2011).

Literature on recreational maths games, more specifically, has focused on the effects of passive recreation games such as computer games (Kebritchi et al., 2010; Al-Mashaqbeh & Al Dweri, 2014; Sayan, 2015; Ezeugwu, Onuorah, Asogwa, & Ukoha, 2016; Chizary & Farhangi, 2017), and video games (Abdullah, Abu-Bakar, Ali, Faye, & Hasan, 2012; Ibrahim & Abu-Hmaid, 2017; Hieftje et.al, 2017) on students' mathsematical performances. In addition, literature on maths anxiety has concentrated on the reasons for maths anxiety and its relationship with students' performance (Siebers, 2015; Puteh & Khalin, 2016; Reali et al, 2016; Luttenberger et al., 2018; Kundu & Kar, 2018). Other researches have examined the effects of maths anxiety on future career choice (Scarpello, 2007; Espino et al., 2017), while others investigated gender differences in maths anxiety (Yüksel-Şahin, 2008; Keshavarzi & Ahmadi, 2013; Yeo, Tan, & Lew, 2015; Hill et al., 2016).

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In summation, the use recreational games to improve maths performance has been limited to passive games such as computer and video games. Studies have not addressed the potential of active recreational maths games to treat maths anxiety and improve maths performance. However, children are more likely to prefer sport and active recreational activities than passive recreation activities (Stodolska, Shinew, & Li, 2010; Ullenhag, Krumlinde-Sundholm, Granlund, & Almqvist, 2014; Smith, Hannon, Brusseau, Fu, & Burns, 2016). In addition, as we have seen, active recreational activities contribute to reduce anxiety (Biddle & Asare, 2011; Goldstein, 2012; Birturk & Karagun, 2015; Paggi et al., 2016). Participation in active recreational maths games may change negative attitudes toward maths and improve maths abilities, since negative experiences with maths contribute to maths anxiety and poor performances (Jansen et al., 2013; Luttenberger et al., 2018). Given this, the theoretical framework of this study is represented in the following figure (1).

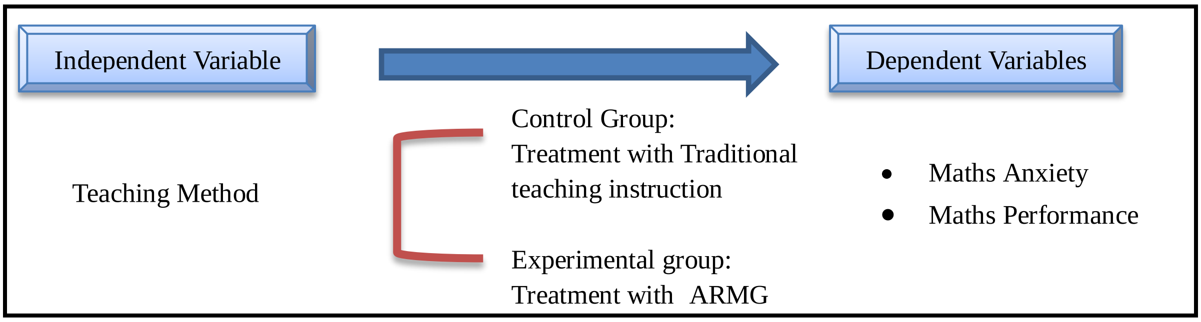

Figure 1. Theoretical framework to examine the effectiveness of active recreation games on maths anxiety and students' performance

To conclude, this study contributes to the existing literature by exploring the effects of active recreational maths games on the alleviation of maths anxiety and the improvement of students' maths performance.

3. Materials and Methods

This study is experimental in nature. Its design includes two groups – the experimental and the control group – a pre-test and a post-test. The population sample consisted of students studying for one semester. Sixty students were recruited from the first year of a primary school in Saudi

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Arabia. A permission was taken from the ministry of education as well as the participants' parents to carry out the study. A parental consent form was also sent to their parents in order to get their approval. The consent form included the main objective and significance of the study. The parents were informed that their sons' participation will be treated confidentially and all information will be kept anonymous, meaning that no one will be able to obtain the answers provided by their sons. Out of 66 parental consent forms sent, 60 ones were received. The participants were randomly divided into two groups (32 in the control group, 28 in the experimental group) by flipping a coin for each student. As stated by Price, Jhangiani, Chiang, Leighton, & Cuttler (2017), random assignment is a key element of all experimental research that allows researchers to assign participants to the different conditions groups. Random assignment should meet two criteria. Each student must have a 50 percent chance of being assigned to each condition and must be assigned to a condition independently of other students (Price et al., 2017). The sample were chosen from one government primary school and was taught by the same teacher to ensure uniformity and equivalence in the traditional way of teaching maths, so as to ensure comparability between the groups. Maths anxiety and performance were pre-tested in both groups to further ensure uniformity and equivalence between the two groups.

The values of mean and standard deviations in Table 1 show that the scores of both groups on the maths anxiety scale and the maths performance test were normally distributed and almost equal. The calculated t-value (less than table value) demonstrates that the difference between the two groups was not significant.

Table 1. Difference between the mean of the pre-test scores of the control group and the experimental group.

Variable	Groups	N	Mean	SD	Df	t-value	P	Remark
Maths anxiety	Experimental	28	2.42	0.271	58	0.498	0.147	Not Significant
	Control	32	2.44	0.268				
Maths performance test	Experimental	28	12.58	2.413	58	0.598	0.496	Not Significant
	Control	32	13.04	2.862				

*** Significant at p≤ 0.05, table value at 0.05 = 2.042.**

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The ARMG sessions were organized for the experimental group over a period of two months, while the control group was taught with traditional maths teaching methods only. The sessions lasted 45 minutes each and took place 3 times a week, for a total of 24 sessions. Each session included a warm-up, a main activity and a cool down. The two groups took a post-test at the end of the experiment, close to the end of the semester, to compare students' performance and anxiety level in both groups. The 60 questionnaires were analyzed using the statistical package for social sciences (SPSS) version 20.0, and the following statistical methods of data analysis were used:

- Descriptive statistics were gathered: means and standard deviations (std).
- Pearson correlation coefficient was used to find out the correlation between maths anxiety and students' performance in mathematics.
- Independent sample t-test was used to determine the differences between the maths anxiety scores of the control group who received TTI and the experimental group who received traditional teaching instruction supported with ARMG.

3.1 Active Recreational Maths Game Design

Several design elements have been explored to improve the benefits of games such as competition, challenge, feedback, uncertainty, goals, fantasy, learner control, cooperation, interactivity, flexibility, and fairness (Burguillo, 2010; Zosh et al., 2017; Chizary & Farhangi, 2017). Cagiltay et al. (2015) recommend six necessary features of games: (i) rules, (ii) variable and quantifiable outcomes, (iii) value assigned to outcomes, (iv) player effort to influence outcomes, (v) participant attached to outcomes, and (vi) negotiable consequences of activities. To guide the participants towards the objectives of the game, the goals and rules to be followed by the participant need to be provided explicitly (Burguillo, 2010; Cagiltay et al., 2015).

In the present study, the design of the ARMG takes several of the abovementioned components into consideration and focused on 1st grade maths objectives and curriculum in Saudi primary school students, including counting, subtraction, additions, shapes, numbers order etc. (see Saudi Arabian 1st grade maths (year 1) curriculum in Appendix). One of the activities exercised in this study to make learning addition and subtraction more enjoyable was by dividing the students into two teams (14 each). A movement story was read containing addition – subtraction questions.

For example, there are (9) baby birds in a nest, four of them flew away, how many are stayed in the nest? A circle was drawn representing the nest for each trailer. Each of them performs the movement story, (9) birds of each trailer get into the nest while (4) players fly away imitating birds sounds while leaving. The trailer that gets the results of the story first is declared winner. Stories of abstraction and addition are repeated using other animals like cats and dogs, imitating their sounds, in order to get the result of such math game.

To ensure the adequacy of the recreational maths games in relation to the physical skills and maths curriculum of 1st graders, the sessions were reviewed by six experts in leisure and recreation field and six experts in maths education. All experts held doctorates and their academic rank ranged between associate professors and professors. Sessions were revised and modified based on the experts' feedback and recommendations.

3.2 The Maths Performance Test

The researcher used a maths performance test to measure the 1st grade students' maths performance. The maths performance test was developed by the researcher. Questions were developed based on the objectives of the maths textbook units. The test consisted of 18 questions covering the maths curriculum. The total mark for the test was 55. To ensure the validity and reliability of the performance test, a panel of six experts in maths education (Trustees validity) reviewed the test and offered some suggestions to improve it. To assess the reliability of the test, a pilot study was implemented. Pilot subjects were excluded from the main study. Three weeks later, the same subjects took the test again and the results were correlated using Pearson's formula. The score obtained, R-value = 0.86, indicated a good reliability.

3.3 Maths Anxiety Scale

The original Mathematics Anxiety Scale for Children was developed by Chiu and Henry (1990) in order to assess the anxiety level of children during certain situations involving maths. The scale has been standardized for primary school populations and has adequate test/retest reliability, internal consistency, and concurrent validity (Wu et al., 2012; Jansen et al., 2013; Keshavarzi & Ahmadi, 2013; Hoorfar & Taleb, 2015).

https://doi.org/10.4995/muse.2020.12622
ISSN: 2341-2593

The Chiu and Henry's scale has been modified and translated into Arabic language by Adnan and Ibrahim (1994) to assess the mathematics anxiety of Arab children in primary schools. The modified Arabic version of the maths anxiety scale includes 23 items, has been used by many researchers (Sawalha & Asfa, 2008; Ladjal, 2016; Ali, 2017), and was found to be reliable and adequate to conduct surveys with primary school students in Arab countries. Cronbach's alpha in the present study was measured as 0.88.

Children rated their level of anxiety in the situation presented in each statement on a 3-point Likert-type scale (1 = not nervous, 2 = a little bit nervous, 3 = very nervous). A high score on the maths anxiety scale was indicative of high maths anxiety. When requested, participants received clarification on the meaning of any item.

4. Results

4.1 The Effect of Maths Anxiety on Students' Performance

Pearson correlation coefficient was used to assess the relationship between maths anxiety and students' maths performance.

Table 2. Correlation level between maths anxiety and students' maths performance in the sample as a whole

Variable	Maths Performance		
	N	**r**	**Remark**
Maths anxiety	60	-.482*	Significant

*** Correlation is significant at the 0.05 level, $p \leq 0.05$ (2-tailed).**

The findings in Table 2 revealed that Sig (significance level) is significant at 0.05 error level. With 95 percent certainty, the result showed negative correlation between maths anxiety and students' performance ($r = -.482$, $p < 0.05$). Students who had high maths anxiety performed poorly in maths.

4.2 The difference in maths anxiety levels between the experimental and control group

Tables 3 and 4 offer descriptive data of the pre-test and post-test scores. The means and standard deviations of the scores obtained on the maths anxiety scale were calculated.

https://doi.org/10.4995/muse.2020.12622
ISSN: 2341-2593

Table (3) pre-test scores of control group and experimental group on maths anxiety scale.

No	Item	Groups	Weighted Mean	SD	Interpretation	Rank
1	Getting a new maths book	Experimental	2.06	0.269	Moderate	21
		Control	1.96	0.269	Moderate	23
2	Reading and interpreting graphs and charts	Experimental	2.15	0.306	Moderate	20
		Control	2.42	0.278	High	13
3	Listening to another student explain a maths problem	Experimental	2.17	0.280	Moderate	19
		Control	2.19	0.273	Moderate	22
4	Watching a teacher work on maths problems on the chalk board	Experimental	2.77	0.259	High	1
		Control	2.65	0.269	High	3
5	Solving a fraction problem	Experimental	2.44	0.291	High	12
		Control	2.49	0.278	High	9
6	Looking through the pages of a maths book	Experimental	2.74	0.255	High	3
		Control	2.76	0.266	High	1
7	Starting a new chapter in a maths book	Experimental	2.30	0.270	Moderate	16
		Control	2.43	0.288	High	12
8	Thinking about maths outside of class	Experimental	1.94	0.305	Moderate	23
		Control	2.24	0.273	Moderate	21
9	Picking up a maths book to begin working on a homework assignment	Experimental	2.56	0.266	High	8
		Control	2.58	0.270	High	6
10	Working on a problem, such as "if I spend $3.87 at the store, how much change would I get from a $5?"	Experimental	2.37	0.295	High	15
		Control	2.47	0.251	High	10
11	Solving an addition problem	Experimental	2.51	0.310	High	9
		Control	2.35	0.281	High	18
12	Listening to the teacher in maths class	Experimental	2.45	0.244	High	11
		Control	2.39	0.269	High	15
13	Being involved in a competition including numerical manipulations	Experimental	2.62	0.291	High	5
		Control	2.59	0.253	High	5
14	Being told how to interpret mathsematical statements	Experimental	2.60	0.236	High	6
		Control	2.64	0.278	High	4
15	Being given many difficult maths problems as a homework assignment due the next day	Experimental	2.73	0.283	High	4
		Control	2.55	0.282	High	7
16	Thinking about a maths test one day before the test	Experimental	2.60	0.301	High	6
		Control	2.51	0.279	High	8
17	Solving a subtraction problem	Experimental	2.22	0.245	Moderate	18
		Control	2.40	0.267	High	14
18	Taking a maths quiz	Experimental	2.28	0.277	Moderate	17
		Control	2.30	0.287	Moderate	19
19	Getting ready to study for a maths test	Experimental	2.50	0.268	High	10
		Control	2.46	0.272	High	11
20	Being given a maths quiz that you were not told about	Experimental	2.44	0.318	High	12
		Control	2.36	0.264	High	17
21	Waiting to get a maths test returned when you expect to have done well	Experimental	2.02	0.302	Moderate	22
		Control	2.27	0.277	Moderate	20
22	Taking an important test in maths class	Experimental	2.38	0.286	High	14
		Control	2.39	0.257	High	15
23	Being asked to answer a maths problem on the chalk board in front of your colleagues	Experimental	2.76	0.279	High	2
		Control	2.74	0.289	High	2
Overall weighted mean		Experimental	2.42	0.271	High	
		Control	2.44	0.268	High	

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https://doi.org/10.4995/muse.2020.12622
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No	Item	Groups	Weighted Mean	SD	Interpretation	Rank
Overall weighted mean for all groups			2.432	0.172	High	

Legend: Low = 1.00-1.66; Moderate= 1.67-2.33; High = 2.34-3.00.

The pre-test scores on the maths anxiety scale are provided in Table 3. The weighted means were used to describe the levels of maths anxiety. A mean between 1.00 and 1.66 was interpreted as a low level of maths anxiety, between 1.67 and 2.33 as a moderate level, and between 2.34 and 3.00 as a high level. The overall weighted mean for the experimental group was 2.42 with a standard deviation of 0.271, and was interpreted as a high level of maths anxiety. For the control group, the overall weighted mean was 2.44 with a standard deviation of 0.268, and was interpreted as a high level of maths anxiety. The overall weighted mean for all groups was 2.432 with a standard deviation of 0.172, and was interpreted as a high level of maths anxiety. These results demonstrate that 1st grade students suffer from high-level maths anxiety.

Table (4) post-test scores of the control group and the experimental group on the maths anxiety scale.

No	Item	Groups	Weighted Mean	SD	Interpretation	Rank
1	Getting a new maths book	Experimental	2.16	0.298	Moderate	6
		Control	2.61	0.197	High	22
2	Reading and interpreting graphs and charts	Experimental	1.98	0.306	Moderate	13
		Control	2.78	0.205	High	13
3	Listening to another student explain a maths problem	Experimental	1.99	0.297	Moderate	12
		Control	2.78	0.214	High	13
4	Watching a teacher work on a maths problem on the chalk board	Experimental	2.27	0.304	Moderate	1
		Control	2.87	0.231	High	3
5	Solving a fraction problem	Experimental	2.09	0.311	Moderate	8
		Control	2.82	0.223	High	8
6	Looking through the pages of a maths book	Experimental	2.01	0.299	Moderate	11
		Control	2.77	0.205	High	16
7	Starting a new chapter in a maths book	Experimental	2.24	0.313	Moderate	2
		Control	2.78	0.213	High	13
8	Thinking about maths outside of class	Experimental	1.90	0.309	Moderate	18
		Control	2.77	0.227	High	16
9	Picking up a maths book to begin working on a homework assignment	Experimental	2.14	0.323	Moderate	7
		Control	2.80	0.218	High	10
10	Working on a problem, such as "if I spend $3.87 at the store, how much change would I get from a $5?"	Experimental	1.93	0.316	Moderate	16
		Control	2.76	0.199	High	18
11	Solving an addition problem	Experimental	1.88	0.295	Moderate	19

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No	Item	Groups	Weighted Mean	SD	Interpretation	Rank
		Control	2.71	0.210		21
12	Listening to the teacher in maths class	Experimental	2.22	0.307	Moderate	3
		Control	2.81	0.219	High	9
13	Being involved in a competition including numerical manipulations	Experimental	1.81	0.301	Moderate	21
		Control	2.79	0.213	High	11
14	Being told how to interpret mathsematical statements	Experimental	1.96	0.298	Moderate	14
		Control	2.79	0.221	High	11
15	Being given many difficult maths problems as a homework assignment due the next day	Experimental	2.03	0.312	Moderate	10
		Control	2.85	0.219	High	6
16	Thinking about a maths test one day before the test	Experimental	1.74	0.322	Moderate	23
		Control	2.74	0.211	High	20
17	Solving a subtraction problem	Experimental	1.96	0.307	Moderate	14
		Control	2.75	0.216	High	19
18	Taking a quiz in maths	Experimental	1.75	0.335	Moderate	22
		Control	2.83	o.217	High	7
19	Getting ready to study for a maths test	Experimental	1.86	0.324	Moderate	20
		Control	2.88	0.224	High	2
20	Being given a maths quiz that you were not told about	Experimental	2.18	0.301	Moderate	5
		Control	2.86	0.209	High	4
21	Waiting to get a maths test returned when you expect to have done well	Experimental	1.92	0.317	Moderate	17
		Control	2.53	0.214	High	23
22	Taking an important test in maths class	Experimental	2.09	0.311	Moderate	8
		Control	2.89	0.198	High	1
23	Being asked to answer a maths problem on the chalk board in front of your colleagues	Experimental	2.19	0.321	Moderate	4
		Control	2.86	0.217	High	4
	Overall weighted mean	Experimental	2.01	0.302	Moderate	
		Control	2.78	0.212	High	
	Overall weighted mean for all groups		2.395	0.189	High	

Legend: Low = 1.00-1.66; Moderate= 1.67-2.33; High = 2.34-3.00.

As can be seen in Table 4, the overall weighted mean for the experimental group was 2.42, with a standard deviation of 0.271, which was interpreted as a high level of maths anxiety. For the control group, the overall weighted mean was 2.44 with a standard deviation of 0.198, which was interpreted as a high level of maths anxiety. The overall weighted mean for all groups is 2.432 with a standard deviation of 0.172, which was interpreted as a high level of maths anxiety. It can be noted from the above tables 3 and 4 that the control group, on average, recorded a higher maths anxiety level on the post-test (M = 2.78; SD = 0.212) than they did on the pre-test (M = 2.44; SD = 0.268). In contrast, the experimental group, on average, recorded a lower level of maths anxiety on the post-test (M = 2.01; SD = 0.302) than they did on the pre-test (M = 2.42; SD = 0.271). The

https://doi.org/10.4995/muse.2020.12622
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difference between the post-test maths anxiety scores of the control and the experimental group was tested with the t-test and 0.05 was set as the significance threshold.

Table 5. Significant difference between the mean of the post-test maths anxiety score in the experimental group and the control group.

Variable	Groups	N	Mean	SD	Df	t-value	P	Remark
Maths anxiety	Experimental Control	28 32	2.01 2.78	0.302 0.212	58	11.283	0.043	Significant

*** Significant at p≤ 0.05, table value at 0.05 = 2.042.**

Table 5 shows that the computed t-value of 11.283 has a significance of 0.043 which is less than the 0.05 threshold. This means that there is a significant difference between the maths anxiety level of the experimental group and the control group according to the post-test. In other words, the experimental group scored significantly lower in maths anxiety than the control group as a result of the ARMG experiment.

4.3 The Difference in Maths Performance Between the Experimental Group and the Control Group

The maths performance of the control group and the experimental group were compared to assess the effectiveness of ARMG on maths performance. The difference was tested with the t-test and the significance threshold was set as 0.05.

Table 6. Significant difference between the means of the post-test performance scores in the experimental group and the control group

Variable	Groups	N	Mean	SD	Df	t-value	P	Remark
Performance test	Experimental Control	28 32	52.39 41.36	3.871 4.949	58	5.166	0.030	Significant

*** Significant at p≤ 0.05, table value at 0.05 = 2.042.**

Table 6 reveals that the computed t-value of 5.166 has a significance of 0.030 which is less than 0.05. Therefore, there is a statistically significant difference between the performance of the

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experimental group and the control group on the post-test. This result implies that the AMRG experiment significantly enhanced students' performance.

5. Discussion

Negative attitudes to maths are common to many countries and cultures. Our study, which found that primary school students in Saudi Arabia report high levels of maths anxiety, is in line with previous studies on maths anxiety among primary education students in Arab countries (Ladjal, 2016; Altakhayinah, 2018) and elsewhere (Yüksel-Şahin, 2008; Olmez & Ozel, 2012; Hill et al., 2016; Caviola, Primi, Chiesi, & Mammarella, 2017). Hill et al. (2016) state that maths anxiety begins at an early age. Therefore, fostering positive experiences should be a priority in the early stages of maths learning to prevent children to develop negative feelings towards maths.

Furthermore, that control group, on average, scored higher on the maths anxiety scale on the post-test than on the pre-test. These measures corroborate two systematic reviews on maths anxiety which found that negative attitudes to mathematics tend to deteriorate linearly with age throughout childhood (Dowker, Sarkar, & Looi, 2016; Luttenberger et al., 2018).

In addition, the results confirmed that maths anxiety has negative effects on maths performance (Wu et al., 2012; Siebers 2015; Reali et al, 2016; Luttenberger et al. 2018). More specifically, this study supports Puteh and Khalin's (2016) argument that a high level of maths anxiety will lower students' success in the subject because anxiety overloads and disrupts working memory during mathsematical tasks (Dowker et al., 2016). On the contrary, low maths anxiety endows the tranquillity and comfort required for students to improve their maths performance.

The mean of the post-test anxiety level scores in the experimental group is significantly lower than in the control group. It can be concluded that the ARMG experiment may reduce anxiety in the experimental group. This result is in agreement with Biddle & Asare (2011) and Eime et al. (2013), who found that children who participate in active recreational activities report fewer symptoms of anxiety than inactive children. A number of recent systematic reviews suggest that active recreation is widely viewed as a key indicator of mental health and well-being (Biddle & Asare, 2011; Eime et

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al., 2013; Rafferty et al., 2016; Johnson, Connolly, & Tully, 2017). Various studies have confirmed that recreation enhances self-concept, self-esteem, self-confidence and self-efficacy, provide social interactions opportunities, and reduces alienation, loneliness and isolation. All these elements can contribute to treat many forms of anxiety (Goldstein, 2012; Paggi et al., 2016; Whitebread et al., 2017).

The findings also show that the experimental group scored significantly higher than the control group on the maths performance post-test. This implies that recreational maths games may be effective to improve students' maths performance. Again, this result is consistent with the findings of Cagiltay et al. (2015), who reported that designed games have the potential to create better learning environments to reach educational and training goals. In contrast, a study conducted by Assad and Wafi (2017) did not find a significant difference in post-test maths performance scores between the control group and the experimental group. The main reason for this difference could be the fact that they used computer games in their study, instead of active recreational games. This discrepancy could suggest that high enjoyment via recreational maths games and competitions contributes to children's willingness to practice the subject, and to persist in the face of difficulties, thereby lowering maths anxiety and increasing maths performance.

Despite these new findings, this study presents some limitations that underline the need for further research. The study was limited to 1st grade students only. The results may not be generalized for students of other grades. Future research might consider whether the same results would be achieved among students of higher or lower ability or interest in maths. In addition, the sample only consisted of male students. The results may not generalize to female classes. Therefore, future research might include female students to determine whether there is a gender differences in maths anxiety and performance based on the experiment. The lack of longer-term analyses is an additional limitation which prevents from determining if the superior knowledge of the experimental group was retained over time.

6. Conclusion

The present study demonstrates that teachers need to be aware of the effects of maths anxiety on students' performance and motivation. They should make an effort to create an environment in which students feel at ease to reduce anxiety and allow them to learn in the best possible conditions. ARMG may be an important opportunity for children to experience positive attitudes towards maths. ARMG may positively predict positive outcomes and, by favoring enjoyment, prevent maths anxiety and consequently improve maths performance. Challenges to the implementation of ARMG include the limitations of the maths curriculum, the limited recreational activities available to address the range of teaching goals and the breadth of knowledge that teachers need to learn to adapt such curricula in ways that address students' recreation needs. Limitations of the 1st grade maths curriculum for addressing learning aimed at transfer and higher order thinking and performance skills which caused maths anxiety and low maths performance. However, there is insufficient strategy supports for teachers to improve maths performance. Creating effective recreational maths games is a challenging task, but one that is also likely to have great benefits for the development and well-being of children.

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