NIGERIAN ONLINE JOURNAL OF EDUCATIONAL SCIENCES AND TECHNOLOGY
nojest.unilag.edu.ng
nojest@unilag.edu.ng

EFFECT OF GAMIFICATION ON LEARNING OF NUMERACY BY ADULT LEARNERS IN LAGOS STATE

OJEOMOGHA, TAWAKALITU OLUWAKEMI
Department of Adult Education,
University of Lagos
kojeomogha@yahoo.com

To cite this article:
Ojeomogha, T. O. (2023). effect of gamification on learning of numeracy by adult learners in Lagos State. *Nigerian Online Journal of Educational Sciences and Technology (NOJEST)*, 5 (1), 215-228

Nigerian Online Journal of Educational Sciences and Technology (NOJEST)

Volume 5, Number 1,2023

EFFECT OF GAMIFICATION ON LEARNING OF NUMERACY BY ADULT LEARNERS IN LAGOS STATE

OJEOMOGHA, TAWAKALITU OLUWAKEMI

Article Infor

Article History

Received:
05 December 2022

Accepted:
March 25, 2023

Keywords
game, Mobile Learning, Numeracy, Adult learners

Abstract

The study evaluated the effect of gamification on learning of numeracy by adult learners in Lagos State, Nigeria. The research design used for this study was a quasi-experimental pre-test post-test control group research design. There are two groups with one group given treatment and the other group serving as the control group. A sample size of 9 adult learners was selected for the study. Simple random sampling technique was used to select one adult literacy centre in Yaba Local Council Development Area and another adult literacy center in Kosofe Local Government Area. The inferential statistics used was t-test and Analysis of Covariance (ANCOVA) at 0.05 level of significance. The learning of numeracy with gamification among adult learners has significant effect on the achievement when compared with their counterpart that was not taught with gamification. Based on the findings from the study, the following conclusions were made there is a significant difference between numeracy achievement scores of learners taught with gamification than those taught without gamification. The study recommended among others that to enhance qualitative and effective teaching and learning of numeracy among adult learners, mobile learning digital games should be incorporated by curriculum developers into the adult education curriculum.

Introduction

Numeracy plays an important role in the daily activities of individuals and across various human professions. Trading and market activities involve the use of numbers; cooking a good meal involves measurement as the cook must use the correct proportion of ingredients. In the same vein, trading activities deal with buying and selling which involve the use of the basic operations: addition, subtraction, multiplication, and division. As a result, numbers are used in the

transactional activities in the work and marketplaces. O'Donoghue (2002) perceived the term numeracy as any one-off a few things including basic computational arithmetic, essential mathematics, social mathematics, survival skills for everyday life, quantitative literacy, mathematical literacy and an aspect of mathematical power. Numeracy is the ability of learners to recognize and understand the role of mathematics in many contexts. It involves choosing the mathematics to use, applying mathematical skills, and evaluating their use to solve problems in the world around us. Alberta Education (2015) defines numeracy as the ability, confidence, and willingness to engage with quantitative and spatial information to make informed decisions in all aspects of daily living. A numerate individual has the confidence and awareness to know when and how to apply quantitative and spatial understandings at home, at school, at work or in the community. In some cases, these individuals are adult learners.

An adult learner is a matured individual who is 25 years and above and involved in various forms of learning. The principles of andragogy follow directly from an understanding of the characteristics of adults as learners and can be recognized when we understand the characteristics of adults and see the way those characteristics influence how adults learn best (citation needed).

The teaching and learning process of numeracy to adult learners in Nigeria has mostly been done through the conventional methods of teaching which to a large extent does not cater for the various domains of learning. Activities involved in these methods are mainly teacher centred not student centred (Ogunbode, 2015). In other words, it involves only the cognitive domain of learning leaving out the affective and psychomotor domains. LSB practitioner training (2014) states that teachers who follow the principles of andragogy when choosing materials for training and designing program delivery find that their learners progress more quickly and are more successful in reaching their goals.

The Canadian Literacy and Learning Network (2013) outlines the 7 key principles of adult learning which distinguish adult learners from children and youth. They are:

a. Adults cannot be made to learn; they will only learn when they are internally motivated to do so.
b. Adults will only learn what they feel they need to learn (practically).
c. Adults learn by doing.
d. Adult learning is problem-based, and these problems must be realistic. Adult learners like finding solutions to problems.
e. Adult learning is affected by the experience each adult brings.
f. Adults learn best informally. Adults learn what they feel they need to know whereas children learn from a curriculum.
g. Adults want guidance.

Based on these principles, andragogy, which also encourages the use of technology such as mobile devices can help meet the present needs of adult learners and make them learn in a ubiquitous environment. These can be achieved with the use of educational games commonly called gamification.

Educational games are designed with the explicit goal of helping learners learn about important subject-matter content, strategies, and cognitive or social skills. Instead of learning by just reading a textbook or listening to a lecture, the learner plays a game that requires engaging curriculum contents and provide learning opportunities as part of the game context. Educational games have potential because the learning of contents with perceived difficulties become an enjoyable and engaging experience for the learner. Intellectual hard work is transformed into play.

Educational games involve students in competition or achievement in relationship to a goal; the game teaches and it is fun (McKeachie, 2002). Many games are simulation with the goal of modelling real-life problems or crisis situations. One advantage of games and simulations is they encourage participants to confront their own attitudes and values (SIilberman & Auerbach, 1998) through involvement in making decisions, solving problems, and reacting to results of their decisions (McKeachie, 2002). Educational games should increase enjoyment, topic interest, and what Csikszentmihaly (1990) calls the flow experience (such intense concentration that time and fatigue disappear). Engagement in the game should facilitate learning by increasing time on task, motivation, and self-regulated activities, as long as the focus is on the instructional curriculum rather than game components that distract from the knowledge and skills to be learned.

One important characteristic of rich gaming environments is that they allow for embedding assessment into the learning context. Shute (2009) has referred to this as "stealth assessment" because no performance is marked specifically as testing; rather, all action is simply part of the flow of a game. Games can also be used with adult learners to warm them up after a long day at the office or carrying out their household duties, in short, games are often welcomed by adult learners as they want to relax a little and make the transition from the outside to the numeracy classroom. It should be noted that some basic factors affect the use of gamification to teach adult learner.

Factors that can affect the use of gamification in teaching adult numeracy are the age, gender, and socio-economic factors of the adult learner. The age of the adult is a key factor in the use of gamification given that some of them see the use of smart phones as being childish or as a waste of money, since they have little or nothing to do with engagements beyond calling and text messaging. Some adults may see it as unnecessary since they can still reach family and friends and make transactions with their business partners through calls. This can make gamification unrealizable since a few adult learners own smart phones.

The socio-economic status is also very important since the use of digital phones depends on the income of the adult learner. In this century, adults are seen as digital immigrants. Digital immigrants are characterized as individuals born before 1980 who knew an analogue-only world and still rely on analogue forms of interaction (Canadian Journal of University Continuing Education, 2013). For digital immigrants, the communication changes happening via the introduction of digital technologies are supposedly learned and relearned, instead of easily becoming second nature (Palfrey and Gasser, 2008). They want to chat with friends and family on social media platforms so must keep up with their social status. The adult learner finds himself to be a digital immigrant as they are forced into using digital technologies.

Research Questions

1. What is the effect of gamification on adult learners' achievement in numeracy?
2. Does gamification have any influence on learners' attitude toward numeracy?

3. What is the influence of gender on the achievement of adult learners taught with mobile learning digital game?
4. What is the influence of gender on the attitude of adult learners taught with mobile learning digital game?

Research Hypothesis

1. Gamification does not have significant effect on learners' achievement in numeracy.
2. There is no significant effect of gamification on learners' attitude towards numeracy.
3. Gender has no influence on the achievement of adult learners taught with mobile learning digital game.
4. Gender has no influence on the attitude of adult learners taught with mobile learning digital game.

Methodology

The research design used for this study was a quasi-experimental pre-test post-test control group research design. There are two groups with one group given treatment and the other group serving as the control group. The treatment group was subjected to the mobile learning digital game package and the control group was exposed to the conventional teaching method with prepared numeracy content. The population of this study comprises of the adult learners in all adult literacy centres in Lagos State of Nigeria. A sample size of 9 adult learners was selected for the study. Simple random sampling technique was used to select one adult literacy centre in Yaba Local Council Development Area and another adult literacy centre in Kosofe Local Government Area. Thereafter, simple random sampling was used to select an intact adult literacy class in each of the adult literacy centres earlier selected. The intact class selected was randomly assigned to treatment and control group. The two intact classes had a total of nine students.

Selected	*Respondents*	*Selected Schools*		
LCDA		*Male*	*Female*	*Total*
Yaba LCDA	Centre A	1	3	4
Kosofe LGA	Centre B	2	3	5
Total		3	6	9

Figures from Table 1 show that male and female adult learners were 3 and 6 respectively. These made up the total sample size of 9 participants.

The following research instruments were used to gather relevant data for the study. These are:

- Mobile Learning Digital Game Package (MLDGP)
- Adult Learning Attitude Questionnaire (ALAQ)
- Numeracy Achievement Test (NAT)

Mobile Learning Digital Game Package (MLDGP)

The Mobile Learning Digital Game Package is an application adopted by the researcher as an intervention to assess the impact of gamification on adult learners' achievement in numeracy. It is an application for adult learners to play with before the post test. The game will train the adult learners on two different topics on numeracy. The game package includes two games to cover the

topics considered in the study. The first game, "Brain Workout" covers arithmetic. It has five levels each with 200 tasks; it is a puzzle-like game where the player is expected to fix the correct number or symbol. The player can start from a level that is suitable for his or her level. The second game is a place value game. It has three options; to learn, to practice and to play games. The game and practice involve task and they both have three levels: easy, medium and hard.

Adult Learners' Attitude Questionnaire (ALAQ)

The questionnaire comprises of two sections. Section A is on demographic data of respondents. Section B contains items on the attitude of adult learners towards the use of mobile learning digital game package. It was rated based on 7-point Likert scale from 'Not at all' to 'Always' the instrument is shown in appendix IV.

Numeracy Achievement Test (NAT)

The Numeracy Achievement Test (NAT) was made up of 10 items divided into three sections. The first section is a multiple-choice question containing 5 items with 3 options (one is key and two are distracters). The second section is a "fill in the gap" question with 5 items. This test instrument was designed to determine the effectiveness of the developed mobile learning digital games package. The items in the NAT were drawn in line with the content of the digital game package which was used to measure the performance of adult learners in both pre-test and post-test. The content validity was ensured by using a Test Blueprint.

Table 2: Test Blueprint for a 10-item Numeracy Achievement Test

Topic	***Weight (%)***	***Knowledge (44%)***	***Comprehension (20%)***	***Application (36%)***	***Total***
Arithmetic	55	2	1	2	5
Numeration	45	2	1	2	5
Total	100	4	2	4	10

The mobile learning digital game package was tested on the adult learners at the two centers. The experiment lasted for 2 weeks the exercise include orientation for the adult education teachers and adult learners; lessons for the two groups; administration of the numeracy achievement pre-test; teaching with the use of the mobile learning digital game package (only for the experimental group) and finally the administration of the numeracy achievement posttest.

Descriptive and inferential statistical tools were used. Mean and Standard Deviation were computed for all the groups where applicable. The inferential statistics used was t-test and Analysis of Covariance (ANCOVA) at 0.05 level of significance.

Result

Descriptive Analyses of Demographic Data

This section described students' variables based on gender, age and class.

Table 3: Gender of Participants

Gender	Frequency	Percent
Male	3	33
Female	6	67
Total	9	100

Concerning gender, from the above table, the percentage of the respondents was 33% male and 67% female. This means that female participants were more than their male counterpart.

Table 4: Distribution of Respondents by Age

Age Range	Frequency	Percent
18-30	1	11
31-40	2	22
41-50	4	45
51-above	2	22
Total	9	100

Table 4 shows that the age range of participants between 18-30 was 11% while participants between 31-40 were 22%. Besides, participants between ages 41-50 and 51-above was 45% and 22% respectively.

Research Hypothesis 1: Gamification does not have significant effect on learners' achievement in numeracy.

Descriptive and inferential statistics were used to respond to hypothesis one. Table 3 contained descriptive analysis of the researcher's observation using mean, standard deviation and mean difference. The analysis of covariance was used to test the hypothesis and the result was presented in Table 5.

Table 5:

Descriptive Analysis of the effect of Gamification on Learners' Achievement

		Pre-test		Post-test		Mean
Experimental Group	N					
		Mean	Std. Dev.	Mean	Std. Dev.	Difference
Treatment	4	0.75	0.96	9.00	0.82	8.25
Control	5	0.60	0.55	1.60	0.55	1.00
Total	9	0.68	0.71	4.89	3.95	4.63

Table 5 shows that the pre-test achievement scores of the participants were 0.75 and 0.60 for the treatment and control groups respectively. However, at post-test, the mean value of the treatment group rose to 9.00, while the control group rose to 1.60. The mean difference shows that the treatment group gained 8.25 as against the 1.00 gain by the participants in the control group. To

determine the significant difference in the mean values, an Analysis of Covariance (ANCOVA) was used to analyze the data and the result of the analysis was presented in Table 6.

Table 6: ANCOVA analysis for Numeracy Achievement

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	122.914[a]	2	61.457	186.735	.000
Intercept	106.414	1	106.414	323.335	.000
Covariate	1.225	1	1.225	3.723	.102
Group	117.470	1	117.470	356.927	.000
Error	1.975	6	.329		
Total	340.000	9			
Corrected Total	124.889	8			

Figures from Table 6 shows that an F calculated value of 356.927 was gotten because of the effect of gamification on achievement in numeracy among adult learners. The calculated value was found to be greater than the critical value of 0.000 given 1 and 6 degrees of freedom. This led to rejecting the null hypothesis. It was concluded that learning numeracy with gamification among adult learners has significant effect on the achievement of adult learners when compared with their counterpart that was not taught with gamification.

Research Question 2: There is no significant effect of gamification on learners' attitude to numeracy.

Descriptive and inferential statistics were used to respond to hypothesis two. Table 5 contained descriptive analysis of the researcher's observation using mean, standard deviation, and mean difference. The analysis of covariance was used to test the hypothesis and the result was presented in Table 7.

Table 7 Descriptive Analysis of the effect of Gamification on Learners' Attitude

Experimental Group	N	Pre-test		Post-test		Mean Difference
		Mean	Std. Dev.	Mean	Std. Dev.	
Treatment	4	28.25	2.22	42.00	6.06	13.75
Control	5	27.00	3.54	29.60	4.04	2.60
Total	9	27.55	2.92	35.11	8.04	8.18

Table 7 shows that the pretest attitude scores of the participants were 28.25 and 27.00 for treatment and control group respectively. However, at posttest, the mean value of the treatment group rose to 42.00, while the control group rose to 29.60. The mean difference shows that the treatment group gained 13.75 as against the 2.60 gain by the participants in the control group. To determine the significant difference in the attitude, mean values, an Analysis of Covariance (ANCOVA) was used to analyse the data and the result of the analysis was presented in Table 8.

Table 8: ANCOVA analysis for Attitude towards Numeracy

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	353.797[a]	2	176.898	6.508	.031
Intercept	47.823	1	47.823	1.759	.233
Covariate	12.108	1	12.108	.445	.529
Group	296.641	1	296.641	10.913	.016
Error	163.092	6	27.182		
Total	11612.000	9			
Corrected Total	516.889	8			

Observation from Table 8 shows that an F calculated value of 10.913 was gotten because of the effect of gamification on the attitude of learners. The calculated value was found to be greater than the critical value of 0.000 given 1 and 6 degrees of freedom. This led to rejecting the null hypothesis. It was concluded that there was significant difference in the attitude of learners taught with gamification towards numeracy than their counterpart that were taught with the conventional method.

Hypothesis Three: Gamification does not have significant effect on male and female learners' achievement in numeracy.

Descriptive and inferential statistics were used to respond to hypothesis three. Table 7 contained descriptive analysis of the researcher's observation using mean, standard deviation, and mean difference. The analysis of covariance was used to test the hypothesis and the result was presented in Table 9.

Table 9: Descriptive Analysis of Learners' Achievement and Gender Pretest Posttest Experimental Mean

Group	Gender	N					Difference
			Mean	Std. Deviation	Mean	Std. Deviation	
Treatment	Male	1	0.00		9.00		9.00
Group	Female	3	1.00	1.00	9.00	1.00	8.00
	Total	4	0.75	0.96	9.00	0.82	8.25
Control	Male	2	0.50	0.71	1.50	0.71	1.00
Group	Female	3	0.67	0.58	1.67	0.58	1.00
	Total	5	0.60	0.55	1.60	0.55	1.00
Total	Male	3	0.33	0.58	4.00	4.36	3.67
	Female	6	0.83	0.75	5.33	4.08	4.50
	Total	9	0.67	0.71	4.89	3.95	4.22

Table 9 shows that, the achievement mean score at pretest was 0.00 and 0.50 for male in treatment and control group respectively. Also, the female participants had 1.00 for treatment group and 0.67

for control group. At posttest, the male participants' achievement mean score rose to 9.00 for the treatment group while the control group rose to 1.50. Similarly, for the female participants, their achievement mean score rose to 9.00 while in the control group, the mean score rose to 1.67. The mean difference treatment group among the male participants was 9.00 while the female participants 8.00. These values were above the total for male and female which was 3.67 and 4.50 respectively. To determine if the achievement mean differences were significant, an analysis of covariance was conducted, and the result presented in Table 10.

Table 10: ANCOVA analysis for Attitude to

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	123.205	4	30.801	73.153	.001
Intercept	106.181	1	106.181	252.180	.000
Covariate	1.482	1	1.482	3.521	.134
Experimental Group	102.703	1	102.703	243.919	.000
Gender	.154	1	.154	.365	.578
Experimental Group * Gender	.228	1	.228	.540	.503
Error	1.684	4	.421		
Total	340.000	9			
Corrected Total	124.889	8			

Table 10 shows that an F calculated value of 0.540 was derived as the effect of gamification among the experimental and control group due to gender. These calculated value (Fcal = 0.540; p > 0.05) was found to the less than the critical value of 0.000 given degrees of freedom 1 and 4 at 0.05 level of significance. Consequently, the null hypothesis was retained, and it was concluded that the use of gamification has not led to significant difference between male and female achievement in numeracy.

Hypothesis Four: Male and female participants' attitude to numeracy does not significantly differ because of using gamification.

Descriptive and inferential statistics were used to respond to hypothesis four. Table 9 contained descriptive analysis of the researcher's observation using mean, standard deviation, and mean difference. The analysis of covariance was used to test the hypothesis and the result was presented in Table 10.

Table 11: Descriptive Analysis of Gamification on Learners' Attitude and Gender Experimental

Pre-test Group	Posttest		Mean	Gender	N		
			Mean	Std. Dev.	Mean	Std. Dev.	Difference
Treatment	Male	1	29.00		46.00		17.00
Group	Female	3	28.00	2.65	40.67	6.66	12.67
	Total	4	28.25	2.22	42.00	6.06	13.75
Control	Male	2	26.50	2.12	28.00	2.83	1.50
Group	Female	3	27.33	4.73	30.67	4.93	3.33
	Total	5	27.00	3.54	29.60	4.04	2.60
Total	Male	3	27.33	2.08	34.00	10.58	6.67
	Female	6	27.67	3.44	35.67	7.58	8.00
	Total	9	27.56	2.92	35.11	8.04	7.56

Table 11 shows that, the attitude mean score at pre-test was 29.00 and 26.50 for male in treatment and control group respectively. Also, the female participants had 28.00 for treatment group and 27.33 for control group. At post-test, the male participants' attitude mean score rose to 46.00 for the treatment group while the control group rose to 28.00. Similarly, for the female participants, their attitude mean score rose to 40.67 while in the control group, the mean score rose to 30.67. The mean difference treatment group among the male participants was 17.00 while the female participants 16.67. These values were above the total for male and female which was 6.67 and 8.00 respectively. To determine if the mean differences in attitude were significant, an analysis of covariance was conducted, and the result presented in Table 10.

Table 12: Inferential Analysis of Attitude for Experimental Groups and Gender

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	378.760[a]	4	94.690	2.742	.176
Intercept	59.209	1	59.209	1.715	.261
Covariate	7.205	1	7.205	.209	.672
Experimental Group	311.881	1	311.881	9.032	.040
Gender	3.144	1	3.144	.091	.778
Experimental Group * Gender	24.540	1	24.540	.711	.447
Error	138.128	4	34.532		
Total	11612.000	9			
Corrected Total	516.889	8			

Table 12 shows that the analysis for gender attitude to numeracy because of using gamification was 0.711. This was found to be insignificant since it ($p > 0.05$) was less than the critical value of 0.000 given degrees of freedom 1 and 4 at 0.05 level of significance. Thus, the null hypothesis

was retained. It was concluded that male and female attitude to numeracy do not differ because of using gamification.

Discussion

The observation from the first hypothesis was that gamification impacted on the achievement in numeracy than their counterpart that was not taught with gamification. The finding from this study varied from the observation of Sayan (2015) who studied the effect of computer games on the achievement of basic mathematical skills among grade 5 elementary school students. The researcher found out no significant difference between the group that learned basic mathematical skills with the aid of math computer games and the other group that learned basic mathematical skills alone without playing computer game. In addition, Stoyanova, Tuparova and Samardzhiev (2017) in their study of the impact of motivation, gamification and learning style on students' interest in mathematics observed that the use of gamification stimulates learners' interest and promote active learning. In addition, Yildirin (2017) observed that gamification-based teaching practices have a positive impact upon students' achievement.

The finding from hypothesis shows that the use of gamification was impactful on adult learners' attitude to numeracy. Hamari and Koivisto (2013) during an empirical study of social motivations to use gamification observed that social factors are strong predictors for attitudes towards gamification, and, further, continued use intentions and intentions to recommend the related service. In the same vein, Yildirin (2017) reported that gamificationbased teaching practices have a positive impact upon learners' attitudes toward lessons. However, Semmar (2006) emphasized the importance of self-efficacy, self-regulation, motivation, and their "synergistic" effect on adults' academic achievement. Besides, Ndlovu and Moyo (2013) reported other affective factors that could influence adult learners' performance in Nkulumane-Emganwini Area of Zimbabwe. Learning style, age and selfconcept were also found to affect performance while marital status and income were found not significantly affecting performance.

Observation on hypothesis three shows that the use of gamification as a method of instruction has not led to significant difference between male and female achievement in numeracy. This finding aligns with the report of Chung and Chang (2017) during their study of the effect of gender on motivation and student's achievement in digital game-based learning. The researchers observed that the usability of the digital game in this study receives positive response from learners regardless of gender. Similarly, Okechukwu, Maduagwuna and Ugama (2014) observed no significant interaction between gender and instructional method on student's achievement in quadratic expression.

The result of hypotheses four shows that male and female participants' attitude do not significantly differ because of using gamification as a method of instruction. The finding aligns with Martí-Parreño, Seguí-Mas and Seguí-Mas (2016) who observed no differences in use of gamification by age, gender or type of institution (public or private). However, the result negates the observation of Koivisto and Hamari (2014) during their study of demographic differences in perceived benefits from gamification. The researchers observed that female enjoy greater benefits from the use of gamification.

Conclusion

Based on the findings from the study, the following conclusions were made;

1. There is a significant difference between numeracy achievement scores of learners taught with gamification than those taught without gamification.
2. There is a significant difference in attitude of learners taught with gamification and those taught without gamification.
3. There is no significant difference between males taught with gamification and females taught with gamification.
4. Male and female participants' attitude to numeracy does not significantly differ because of using gamification.

Recommendations

Based on the findings of this study, the following are recommended.

1. In order to enhance qualitative and effective teaching and learning of numeracy among adult learners, mobile learning digital games should be incorporated by curriculum developers into the adult education curriculum.
2. The use of the mobile learning digital games for teaching numeracy to adult education should be encouraged in the adult literacy centres as it enhances effective learning.
3. Since gender is not a determinant of adult learners' achievement and attitude when taught through mobile learning digital games. Therefore, facilitators should put in more effort on equal distribution of attention to both male and female adult learners.
4. Stakeholders should endeavour to provide adult learning centres with well-equipped learning resources and facilities that can be used with the mobile learning digital game to improve learning.

Adult educators (facilitators) should learn how to develop or adopt mobile learning digital games for various contents in the adult education.

References

Alberta Education (2015). What is numeracy? Available online at https://education.alberta.ca/literacy-and-numeracy/numeracy/everyone/what-isnumeracy/

Canadian literacy and learning network.Principles of adult learning. Archived 2014-02-17 way back machine. Jossy Bass. 2013.

Chung, L., & Chang, R. (2017). The Effect of Gender on Motivation and Student Achievement in Digital Game-based Learning: A Case Study of a Contented-Based Classroom. *EURASIA Journal of Mathematics, Science and Technology Education, 13*(6), 2309– 2327

Ferguson, T.L.(2014). Mathematics achievement with digital game-based learning in high school algebra 1 class.Liberty University, Lynchburg, VA. Ginsberg, K. (2007). The importance of play in promoting healthy child development and

Hamari, J., & Koivisto, J. (2013). *Social motivations to use gamification: an empirical study of gamifying exercise*. In Proceedings of the 21st European Conference on Information Systems, Utrecht, Netherlands, June 5–8, 2013. Harper and Row.

Huotari, K., & Hamari, J. (2012). "Defining Gamification – A Service Marketing Perspective" (PDF). *Proceedings of the 16th International Academic MindTrek Conference 2012, Tampere, Finland, October 3–5.*

Kagan, S. L. & Lowenstein, A. E. (2004). School readiness and children's play:

Koivisto, J., & Hamari, J. (2014). Demographic differences in perceived benefits from gamification. *Computers in Human Behavior, 35*, 179-188.

LSB Practitioner Training: professional development support for literacy and basic skill education in Ontario "principles of adult learning". Retrieved 19 October 2014. maintaining strong parent-child bonds. *Pediatrics.*119(1), 182-191.

O'Donoghue, J. (2002). Numeracy and mathematics. *Irish Mathematics & Social Bulletin, 48*, 47–55.

Okechukwu, A., Maduagwuna, N., & Ugama, J. O. (2014). Effect of Mathematical Game on Students Achievement in Quadratic Expressions. International Journal of Scientific and Engineering Research, 5(6), 678 – 684.

Sayan, H. (2015). The effects of computer games on the achievement of basic mathematical skills. *Educational Research and Reviews, 10*(22), 2846-2853.DOI: 10.5897/ERR2015.2172

Shute, V. J., Ventura, M., Bauer, M. I., & Zapata-Rivera, D. (2009). Melding the power of

Stoyanova, M., Tuparova, D., & Samardzhiev, K. (2017, September). *Impact of Motivation, Gamification and Learning Style on Students' Interest in Maths Classes–A Study in 11 High School Grade i*n International Conference on Interactive Collaborative Learning (pp. 133-142). Springer, Cham.

Yildirim, I. (2017). The effects of gamification-based teaching practices on student achievement and students' attitudes toward lessons. *The Internet and Higher Education, 33*, 86-92. Mumj