Influence of Adventure-Type ICT-Based Arithmetic Educational Game On Mathematics Learning Achievement At SDIT (Sekolah Dasar Islam Terpadu/Integrated Islamic Elementary School) Insan Mandiri

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Abstract

Educational games are a type of game which has learning objectives and is designed for educational purpose. One of type of such game is an adventure-type ICT-Based educational game which is used as an arithmetic exercise for students. This research aims at finding out if an adventure-type ICT-based arithmetic educational game has a positive influence on elementary school students' mathematics learning achievement and how influential the game is. The research utilizes the quasi experimental method of the non-randomized control pretest-posttest design. The research samples are 50 elementary school first graders of SDIT (Sekolah Dasar Islam Terpadu/ Integrated Islamic Elementary School) Insan Mandiri, located at South Jakarta. The research outcome shows that at the significance level of 0.033, the Mann Whitney test resulted in the significant increase on the treatment group. Most of the students' scores increase 8.14% in the treatment group and 3.55% in the control group. Based on the outcome of the research, it can be concluded that the adventure-type ICT-based arithmetic educational game can be used as a supplement and exercise that support the face-to-face learning result.

Keywords: *learning result, educational games, arithmetic, distance learning*

1. INTRODUCTION

1.1. Background

Arithmetic is addition, subtraction, multiplication and division operations of integers (Kamus Bahasa Indonesia, 2012; Prather & Alibali, 2008). Arithmetic learning starts in the elementary school level. Arithmetic is considered important in daily life and closely relates to other sciences. Prather & Alibali (2009) stated that basic arithmetic principles are key aspects in mathematics. It implies that arithmetic ability may influence one's mathematics scores or mathematics accomplishments. However, reality shows that elementary school students have insufficient understanding on arithmetic concepts, which can both directly and indirectly influence their mathematics learning achievements. That said, in a 21st classroom, learning media which are enjoyable and actively involve the elementary students are needed to improve their arithmetic ability. One of such learning media that can be a solution is Adventure-Type ICT-Based Arithmetic Educational Game.

Chen et al (2012) in his research on ICT-based educational game combined with collaborative learning as an effort in improving students' arithmetic ability stated that ICT-based educational games can improve average elementary school students' learning achievements by 25.85%. The similar result is shown by Sari & Listyorini (2011) in their research on ICT-based educational game as learning media for mathematics logics. The research shows that an ICT-based educational game can improve students' learning achievements. Through their research Sari & Listyorini show that after the use of the game the number of students who get below-average scores decreases by 11.6%. This shows an increase in the number of students who get scores that are above the class average. Based on the increase in the students' learning achievements, the probability of an ICT-Based Arithmetic Educational Game to increase students' learning achievements is quite high.

Based on the previous researches showing an increase in learning achievements and students' interest, after the use of the educational game and high interest of game players in adventure-type games and the potential of an adventure-type game to be transformed into an educational game, the researchers wish to find out if an adventure-type ICT-based arithmetic educational game can increase elementary school students' mathematics learning achievements.

1.2. Statement of Problem

In this research, ICT-based games refer to the games played online on PC computers or laptops. The name of the game used in this research is "Petualangan Kabayan" (Kabayan's Advetures) which can be accessed at edu-crystalmaiden.net.

Arithmetic concepts integrated into Petualangan Kabayan are developed based on elementary students' mathematics Competence Standards and Basic Competence. The arithmetic materials integrated in the game consist of 1-20 addition and 1-20 subtraction operations.

Based on the background and the statement of problem, the research questions can be elaborated as follows:

1. Is there any influence of the adventure-type ICT-based arithmetic educational game on the increase of the learning achievements of the first graders of SDIT Insan Mandiri students?
2. How influential is the adventure-type ICT-based arithmetic educational game on increasing the learning achievements of the first graders of SDIT Insan Mandiri students?

1.3. Research Objectives

The objectives of this research are:

To find out if there is any influence of the adventure-type ICT-based arithmetic educational game on the increase of the learning achievements of the first graders of SDIT Insan Mandiri students.

To find out the magnitude of influence of the adventure-type ICT-based arithmetic educational game is on increasing the learning achievements of the first graders of SDIT Insan Mandiri students.

1.4. Urgency

The research is expected to be a reference for educators wishing to use learning media which is diverse, enjoyable and motivating. Teachers and prospective teachers can use this research as a reference for mathematics learning using ICT-based multimedia especially arithmetic educational game. Educational researchers can use this research as one of references which can be used to investigate learning using ICT-based media or arithmetic educational game. Students can use the game to improve their understanding on arithmetic operations, to improve their learning achievements, and to develop the habit doing self-instructional learning activities.

2. LITERATURE REVIEW

2.1. Learning achievement

Mochtar in Salinan (2011) stated that learning achievement is a result obtained or shown by an individual as a gain from learning in forms of cognitive, psychomotor or affective skills which reflect learning gain accomplished by each child in a certain period. Anni in Hendikwati (2011) stated that two factors influencing learning achievement are internal factor and external factor. The internal factor consists of 1) physical aspect such as health

2) psychological aspect such as intellectuality, emotion and 3) social aspect such as the ability in socializing with the surrounding environment. The external factor comes from outside students such as the variety and the level of difficulty of the material learned, place of study, climate, the atmosphere of the environment, the society's learning culture and so on. Anni's statement is reinforced by Purwanto in Hendikwati (2011) in which he stated that factors influencing learning achievement are factors from inside and outside the students. Factors from inside students are factors relating to students' physiological states such as physical condition, condition of the senses, and psychological condition relating to interest, level of intelligence, talent, motivation and cognitive ability. Factors from outside students include curriculum in use, teachers' characters, facilities and management prevailing in the school.

2.2. Arithmetic

Arithmetic is addition, subtraction, multiplication and division operations on integers (Kamus Besar Bahasa Indonesia, 2012; Prather & Alibali, 2008). Based on its role in mathematics, arithmetic is a key aspect in mathematics (Prather & Alibali, 2009). Based on the definitions, arithmetic can be defined as a key aspect in mathematics which deals with calculation operations such as addition, subtraction, multiplication and division of integers.

2.3. Adventure-type ICT-Based Arithmetic Educational Game

Educational games are a type of games which has learning purposes and is educational-oriented (Chen et al, 2012; Amory & Seagram, 2003). Arsyad (2008) stated that ICT-based educational games are types of learning media which resorts to computers and designed to motivate and increase students' knowledge and skills gain. ICT-based adventure games are games which follow a flow of story and players play in an artificial world to collect required objects or things and accomplish missions given (Felicia, 2009). Based on the definitions it can be said that adventure-type ICT-based arithmetic educational games integrate arithmetic into ICT-based educational games which are played in an artificial world and players are provided with missions or challenges designed to achieve arithmetic learning objectives.

2.4. Blended Learning

Blended learning is an approach to learning which combines face-to-face method and computer-mediated activities to create an integrated learning atmosphere. In this approach, digital learning material is used as supplements to assist face-to-face learning.

Adventure-type ICT-based arithmetic educational game is one of the specifications of ICT-based Educational games. That said,

3. RESEARCH METHODOLOGY

3.1. Approach and Research Type

The research method used is *Quasi Experimental Research* which is also called *Quasi Experimental Design*. This type of research aims at finding out the causal relationship resulted through the manipulation of independent variables towards dependent variables (Fraenkel, Wallen, & Hyun, 2012; Cohen, Manion, & Morrison, 2000). In this research, the experimental research design used is *non-randomized control pretest-posttest design*. The definition of non-randomized control pretest-posttest design is one of research types which tests the influence or the effectiveness of a treatment through a comparison of pretest and posttest results on an experiment group and a control group in which members of both groups follow the predetermined grouping (Fraenkel, Wallen & Hyun, 2012; Asner-Self & Schreiber, 2011). In this research, the grouping is carried out based on classes. The following is a diagram illustrating the experimental method using Non randomized control pretest-posttest only group design:

G1	**O_1**	**X_T**	**O_2**
Group 1	***Pretest***	***Treatment***	***Posttest***
G2	**O_2**	**X_C**	**O_2**
Group 2	***Pretest***	***Control***	***Posttest***

Diagram illustrating Non randomized control pretest-posttest design in quasi experimental research

3.2. Population and Sample

Sukardi (2008) postulated that population is all group members who stay together in a place and designated to be target of generalization of final outcome of a research. The population of this research is all the 76 first graders of elementary school of SDIT Insan Mandiri, South Jakarta.

Sukardi (2003) postulated that sample is part of a population representing the condition of the population. Sukardi added that in the selection of sample several matters must be taken into account: 1) sample has to be part of population 2) sample profile has to represent the population 3) sample has to be part of access population which is the number of group members encountered in the field.

Based on the population in the research, the sample of the research is two out of three classes at SDIT Insan Mandiri which are Class 1-A and Class 1-B. sampling method used in the research is convenience sampling. The method is opted because the school has already determined the classes.

3.3. Research Procedure

The research procedure consists of:

Planning Stage	Execution Stage	Final Stage
a) Literature review	a) Administering pre-test	a) Organizing data obtained from the research
b) Determining research hypothesis, research method, population and sample, and prerequisites for research instruments	b) Administering treatment	b) Analyzing research findings
c) Creating research instrument	c) Administering *posttest*	c) Drawing conclusion from research findings
d) Asking for permission from the elementary school where the research is conducted		

3.4. Research Instrument

In order to find out the relationship between the adventure-type ICT-based arithmetic educational game and the mathematics learning achievement, the research instrument has to meet the following prerequisites:

1. The research instrument is mathematics problems for elementary first graders
2. The level of difficulty of the research instrument is easy to difficult
3. The teaching material covered in the research instrument is in conformity with competence standards and basic competence for year 1 of elementary school
4. The number of problems in the pretest and posttest is 20

4. DATA ANALYSIS

4.1. Validity and Reliability of the Instrument

The obtained data are selected based on the students' presence in a span of three meetings. Data obtained consist of 39 data pairs (pretest and posttest) from 39 students. The number of N in the validity test and reliability test is 39.

The result of the validity test and reliability of the instrument for the pretest problems in the final iteration after several iterations with SPSS is as follows:

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,880	,888	11

Table 4.1 Cronbach's Alpha in pretest

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,836	,869	10

Table 4.2 Cronbach's Alpha in posttest

	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Pre6	,404	,880
Pre8	,702	,861
Pre9	,775	,859
Pre10	,590	,869
Pre11	,650	,870
Pre12	,452	,878
Pre13	,452	,878
Pre17	,685	,863
Pre18	,693	,863
Pre19	,597	,869
Pre20	,629	,868

Table 4.3 r values and Cronbach's Alpha in valid and reliable items in pretest

	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Post6	,525	,828
Post9	,525	,828
Post11	,376	,834
Post12	,651	,815
Post13	,525	,828
Post16	,556	,824
Post17	,481	,831
Post18	,748	,795
Post19	,482	,825
Post20	,754	,795

Table 4.4 r values and Cronbach's Alpha in valid and reliable items in posttest

Table r which uses alpha 0.05 indicates that correlation below 0.2763 is considered not valid. Table 4.2, in the corrected item-total correlation column, shows that no scores are less than 0.2763. It can be concluded that problems numbered 6, 8, 9, 10, 11, 12, 13, 17, 18, 19, and 20 are valid with reliability of 0.88 or 88%. Table 4.4, in the corrected item-total correlation, shows no scores are less than 0.2763. It can be concluded that problems numbered 6, 9, 10, 11, 12, 13, 17, 18, 19 and 20 are valid with reliability of 0.836 or 83.6%. Based on the validity test and reliability test in the pretest and posttest, the researchers take 10 valid problems in the pretest and posttest. This is so done because the pretest and posttest have the same indicators and the comparison measure the similar competencies. That said, the 10 problems taken by the researchers are problems numbered 6, 9, 11, 12, 13, 16, 17, 18, 19 and 20.

4.2. Data Normality Test

The analyzed data are as follows:

No	Treatment Group		Control Group	
	Pretest	Posttest	Pretest	Posttest
1	6	9	10	10
2	6	10	10	10
3	10	10	10	10
4	8	10	10	9
5	7	8	8	10
6	10	10	8	8
7	8	10	5	5
8	10	10	10	10
9	10	10	10	10
10	9	10	10	10
11	10	9	4	5
12	10	10	9	9
13	10	10	10	7
14	10	10	10	7
15	10	10	6	7
16	10	10	10	10
17	9	10	1	9
18	9	10		
19	10	10		

Table 4.5: Data after the elimination of outliers

The researchers use Kolmogorov-Smirnov to test the normality of data. The alpha (α) value used is 0.05. The result of the data normality test in the pretest and posttest using SPSS is as follows:

a. Lilliefors Significance Correction

		Kolmogorov-Smirnov[a]		
	Grouping	Statistic	df	**Sig.**
Pretest	Control	,324	17	**,000**
	Treatment	,331	19	**,000**

Table 4.6a. Pretest data normality test

b. Lilliefors Significance Correction

		Kolmogorov-Smirnov[a]		
	Grouping	Statistic	df	**Sig.**
Posttest	Control	,258	17	**,004**
	Treatment	,495	19	**,000**

Table 4.6b. Posttest data normality test

Both data normality tests show that significant values are less than alpha (0.05) both in the control group and the treatment group. It can be concluded that the data distribution in the pretest and posttest is not normal. Therefore, the researchers use Wilcoxon Test to find out the significance between the pretest and posttest from each control group and treatment group. The researchers also use Mann Whitney U Test to find out the significance of the posttest between the control group and the treatment group.

4.3. Wilcoxon Test

To find out the significance of the influence of the exercise by ma king use of the game (treatment) and the exercise without the game, the researchers use Wilcoxon Test in each treatment group and control group.

4.3.1 Wilcoxon Test on Treatment Group

Tabel 4.7 Result Descriptive statistics of treatment group

	N	Mean	Std. Deviation	Minimum	Maximum
Pretest	19	9,0526	1,39338	6,00	10,00
Posttest	19	9,7895	,53530	8,00	10,00

Tabel 4.8 Result of Wilcoxon Test Signed Rank grup treatment

		N	Mean Rank	Sum of Ranks
posttest - pretest	Negative Ranks	1[a]	3,00	3,00
	Positive Ranks	8[b]	5,25	42,00
	Ties	10[c]		
	Total	19		

a. posttest < pretest

b. posttest > pretest

c. posttest = pretest

Tabel 4.9 Statistical Test[b]

	posttest - pretest
Z	-2,354[a]
Asymp. Sig. (2-tailed)	,019

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

The mean value of the treatment group in table 4.7 shows an average increase of scores from the pretest to the posttest. The increase is from 9.0526 to 9.7895 or in another word the average increases by 8.14% after the treatment. Wilcoxon test in table 4.8 shows 5.3% of the students have a decrease in their scores, 42.1% have an increase and 52.6% have no change in their scores after the use of the educational game. Based on the asymp.sig value from the statistical test in Table 4.9 which is less than α (0.05), it can be concluded that there is a significant difference in the pretest and posttest. This indicates that arithmetic exercises by making use of arithmetic educational game yields a positive influence on the students' mathematics learning achievement.

4.3.2 Wilcoxon Test on Control Group

Tabel 4.10 Descriptive statistics on control group

	N	Mean	Std. Deviation	Minimum	Maximum
prec	17	8,2941	2,71027	1,00	10,00
postc	17	8,5882	1,76985	5,00	10,00

Tabel 4.11 Result of Wilcoxon Test Signed Rank grup treatment

		N	Mean Rank	Sum of Ranks
posttest - pretest	Negative Ranks	3[a]	4,33	13,00
	Positive Ranks	4[b]	3,75	15,00
	Ties	10[c]		
	Total	17		

a. posttest < pretest

b. posttest > pretest

c. posttest = pretest

Tabel 4.12 Statistical test[b]

	posttest – pretest
Z	-,171[a]
Asymp. Sig. (2-tailed)	,865

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

The mean value of the treatment group in table 4.10 shows an average increase of scores from the pretest to the posttest. The increase is from 8.2941 to 8.5882 or in another word the students' average scores increase by 3.55% after the regular mathematics exercises. Wilcoxon test in table 4.11 shows 17.6% have a decrease in their scores, 23.6% have an increase and 58.8% have no change in their scores after the mathematics exercises. Based on the asymp.sig from the statistical test on table 4.12 which is less than α (0.05), it can be concluded that there is no significant difference between the pretest and the posttest. This indicates that the regular arithmetic exercises can increase the students' learning achievement but not significantly.

4.4. Mann-Whitney U Test

Table 4.13 Mann Whitney U Test

	Grouping	N	Mean Rank	Sum of Ranks
Posttest	Control	17	14,56	247,50
	Treatment	19	22,03	418,50
	Total	36		

Table 4.14 Statistical test[b]

	Posttest
Mann-Whitney U	94,500
Wilcoxon W	247,500
Z	-2,536
Asymp. Sig. (2-tailed)	,011
Exact Sig. [2*(1-tailed Sig.)]	**,033**[a]

a. Not corrected for ties.
b. Grouping Variable: Grouping

Based on the asymp.sig value from Mann-Whitney U Test which is less than α (0.05), it can be concluded that there is a significant difference between control group's posttest and treatment group's posttest. This indicates that the exercise using the arithmetic game yields more positive influence in the students' mathematics learning achievement than that without the arithmetic educational game.

5. CONSLUSION AND SUGGESTION

5.1. Conclusion

The result of Wilcoxon test on the treatment group and the control group shows:

1. Students' scores in average increase by 8.14% in the treatment group and 3.55% in the control group.
2. In the treatment group, 5.3% of the students have a decrease, 42.1% have an increase and 52.6% have no change after the educational game is in use. In the control group, 17.6% of the students have a decrease in their scores, 23.6% have an increase and 58.8% have no change.
3. In the treatment group, the asymp.sig value of 0.019 from the statistical test which is less than α (0.05) shows a significant difference between the pretest and the posttest. In the control group, the asymp.sig value of 0.865 from the statistical test which is less than α (0.05) shows no significant difference between the pretest and posttest.

Wilcoxon test result shows that the arithmetic exercises using the arithmetic educational game yields a positive influence on the students' mathematics learning achievement and are able to increase the students' average scores by 8.15%. Whereas mathematics exercises without the educational game show an increase of 3.55% and shows no significant increase in Wilcoxon Test. Mann-Whitney Test shows asymp.sig value of 0.033 which is less than α (0.05) which demonstrates a significant difference between the control group's posttest and that of the treatment group. This indicates that exercises using the arithmetic game yield a positive influence on the students' mathematics learning achievement than that without the game.

5.2. Suggestion

Sample in this research focuses only on elementary school first graders. It is suggested that in the next research the focus be from first graders to six graders with a wider scope so that it can be learned if the arithmetic educational game can increase elementary school students' mathematics learning achievement.

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