The Effect of Using Computerize Software to Solving the Problem of Fractions Learning
Case Study: Economic Course

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Abstract — **This paper focuses on using and evaluating of an educational software as an attempt to facilitate the teaching of fractions in Economics, a subject that is often regarded as complicated by students of all ages. An experiment was carried out to investigate how the software affects fraction learning. Two groups, a control and experimental, were assigned. Controlled students have learned fractions by traditional teaching method. While experimental students have learned fraction by using software game related to fraction learning. This paper presents a qualitative results for two groups and illustrated that the students in the experimental group performed better when using Computer game than the control group with traditional teaching method.**

The results obtained indicate that the educational software improve the learning process, for example control group obtained a mean score with 5.56, while the experimental group obtained a mean score of 6.34. The t value was 2.05, However the p-value was significant with a p-value of 0.044 (p<0.05). This results indicate that we reject the null hypothesis (There is no difference between the mean grades for the two groups). This means that the difference in the man score of both two groups was significant. This independent sample t-test was done to examine whether any significant differences exist between the posttest mean score of both the Control and Experimental group.

Keywords: Fractions, Learning Achievement, ICT-Based Learning, Successful Learning

INTRODUCTION

The researchers noticed that the problem of some students in obtaining a high score in the Economics exam was due to fractions faulty, which resulted in students getting less marks because they did not reach the right final answer. Other questions depends on the final answer such as the type of flexibility.

Fractions have long been described by educational researchers as a challenging area of the curriculum for students in mathematics [19]. Fractions are also one of the important concepts that allow us to understand this hierarchical structure of mathematics. Student' lack of understanding fraction concept raises many problems in the following topics such as fraction computation, decimal and percent concepts, and other concepts areas which require the use of fractions [4].

One of the topics that primary school students in unable to master in fraction. Traditional teaching approach using inconsistent teaching aids can confuse the students who are trying to develop the concepts of fraction. Besides, manipulating numbers approach is only suitable for the bright students and those who can memorize the steps to get the answers. There is even some occasion when students can give the correct answer although they don't really understand the concept itself. When these students are tested with higher order thinking type of questions, they may face difficulties as they do not have sufficient conceptual knowledge of fraction.

OBJECTIVE OF RESEARCH

The main objective of this study was to investigate the effect of Computerized Software on fraction understanding for the students.

LITERATURE REVIEW

1. Importance of Fraction in Post-School Experience

Fractions is an important concept in mathematics course of elementary school students [11]. However, according to Booker [7], fraction in not an easy concept to learn. If school students cannot understand this concepts of fraction, they will experience and face learning difficulties with other related mathematical topics in high school, and in university in future.

School success in mathematics contributes to higher earning. A national longitudinal study found that after controlling for the effects of number of years in school, adults with stronger mathematical skills (including fractions) had significantly wages that adults with lower mathematical achievement [8].

Teachers' ability to identify the conceptual origins of student difficulties, predict misconceptions, and relate current to future curriculum topics is enabled by their disciplinary and pedagogical content knowledge [10]. Generalist teachers in

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elementary schools and high school teachers assigned mathematics classes outside their specialization, might not have had the opportunity to develop the conceptual foundations required to promote deep understanding of fractions [19].

2. *Challenges understanding fractions*

Many children and adults struggles with fractions. On one National Assessment of Educational Progress (NAEP), an a nationwide test given to a very large, representative sample of U.S Children, only 49% of eighth graders correctly ordered 2/7 , ½ and 5/9 from least to greatest. On another NAEP, only 55% of 8th graders correctly solved a simple word problem involving fraction division. Despite fraction instruction beginning in elementary school, many people fail to gain a firm understanding of fractions and harbor misconceptions through high school and college [9]

However, clear the objectives for learning fractions, the mathematics education literature is resounding in its findings that understanding fractions is a challenging area of mathematics for North American students to grasp [14]. Students also seem to have difficulty retaining fractions concepts [15]. Adults continue to struggle with fractions concepts (the Electronic Journal of Mathematics and Technology) [6], even when fractions are important to daily work related tasks. For example, "pediatricians, nurses, and pharmacists…were tested for errors resulting from the calculation of drug doses for neonatal intensive care infants… Of the calculation errors identified, 38.5% of pediatricians' errors, 56% of nurses' errors, and 1% of pharmacists' errors would have resulted

3. *Information and Communication Technology (ICT) In Mathematics*

Numerous numbers of studies on integrating ICT in teaching and learning mathematics received various responses mostly from teachers. Some of them are for it, while some are against it. There are also those who will consider to use it given certain circumstances. This might be the case of experienced teachers who are already comfortable with their current way of teaching [1]. Nevertheless, it doesn't mean that they totally reject the idea of integrating ICT into teaching and learning as a whole, and mathematics particularly. Given enough training and authorities to select and decide what and how to use them in class would increase teachers' perception towards integrating ICT in classroom [21].

Game making has the potential to be a powerful learning environment according to attributes identified by Smeets in 2005 [20]. Making games is a rich task, in that it offers opportunities for children exercise a wide spectrum of skills (such as devising game rules, creating characters and dialogue, visual design, and computer programming) to create a complex arteifact. It is also authentic on the grounds that the resulting artefact is of value in popular culture and can be enjoyed by friends at home or at school. Making a game actively engages learners because they construct their own game using a software tool; it is not a passive experience. Pupils can learn autonomously using the software as a sounding board for their ideas – they can embody their creative ideas in a testable way in their game and then try it to evaluate their ideas [18].

There are several studies that report on the use of commercial computer games for mathematics, or present the development and evaluation of instructional games designed for the specific subject. As indicated by the following review of relevant studies, computer games can increase students' math achievement and performance, and promote positive attitudes towards mathematics. For instance, in a recent study, Pareto et al in 2011 [16], created a teachable-agent arithmetic game that aims in training basic arithmetic's skills. The game was evaluated in a study with 153 participants, consisting of 3rd and 5th grade students. The results indicate that the game helped students improve their math performance and self-efficacy beliefs. Ahmad and Latih in 2010 [22] describe the development of an educational math game on fractions for primary school students. Similarly, Lee in 2009 report on the creation and evaluation of an education game on fractions and mention that it improved students' understanding and performance [2].

4. *ICT in Palestine*

The state of Palestine, regardless of what its final borders are/will be, is small and limited in natural assets. Its people are its primary resource: population has increased in the past 10 years and due to high fertility rates and the continuing migration of young adults in search of employment the percentage of young people is very high. More than 30% of the Palestinian population are full-time students enrolled in school or university (more than one million students) so education in Palestine2 has become a community investment in human resources whose benefits are not only economic, but also cultural and social [5].

Although ICT in Palestine is seen as an important key to combating unemployment, sharing knowledge, overcoming restrictions on movement, ICT diffusion in the Palestinian education system is still faraway from being realized. "According to the MOE reports, 40 percent of the schools (2109) house computers labs (13 computers in each lab), while a small percentage of these labs are connected to the Internet" [13]. Many computers are very old and labs are used only during the technology class (45 minutes/week); the MoEHE does not allow schools to use their budget to connect to Internet4 ; most of teachers do not use computers even when they had training courses in ICT because of lack of practice. Computers and Internet are more diffused at teachers and students' homes but it depends on how teachers and parents perceive ICT [5].

5. *PPU Progression Towards an Entrepreneurial University Mode*

Palestine Polytechnic University (PPU) changed its vision with new vision to: Towards Science, Technology, and Innovation Entrepreneurial University by the year 2016. PPU Entrepreneurial university development imperatives to be achieved by (Conducting more assignment and consultancies,

Focusing on personal development of students (ie, entrepreneurial attitude, competences and character), not just academic content, Offering tailored career and employment guidance, Providing advice and assistance to students to start new businesses, and Developing staff competencies in 'enterprising teaching' methods. [17].

Palestinian Polytechnic University has developed its vision "Towards Science, Technology, and Innovation Entrepreneurial University", and has developed a model to the transmission of the Entrepreneurial University. [17].

The Below Figure 1 Shows PPU Entrepreneurial University Development:

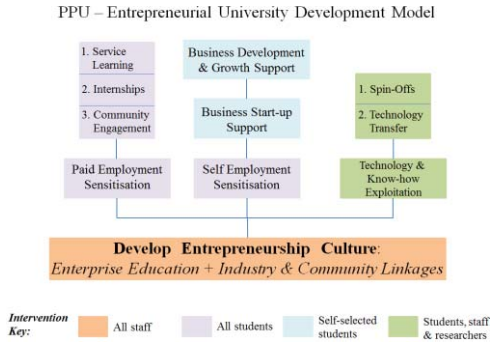

Figure 1: EC-OECD Framework for Entrepreneurial Universities, Source: (PPU, 2014)

METHODOLOGY

Price elasticity of demand measures the responsiveness of demand to a change in price, where the Elasticity of supply measures the responsiveness of supply to a change in price.

Price inelastic – a change in price causes a smaller %change in demand. Price elastic – a change in price causes a bigger % change in demand. Elasticity of supply measures the responsiveness of supply to a change in price, Inelastic supply means an increase in price causes a smaller % change in supply. It means firms have difficulty increasing supply in response to a rise in price.

Both the elasticity of supply and demands using the following formulas:

$$\text{Price elasticity of Supply} = \frac{\%\text{change in Supply}}{\%\text{change in Price}}$$

$$\text{Price elasticity of Demand} = \frac{\%\text{change in Demand}}{\%\text{change in Price}}$$

First exam was used as a Pretest exam for the students.

Wageez Math is a compact application designed to help Students in learning the basic math operations. The program allows Students to answer a series of questions in the Interactive mode and provides them with the answer after a few seconds in. Students can select the type of operation (Addition, Subtraction, Multiplication, Approximation, Common fractions, Decimal fractions, Math Games).

1. Research Design and Sample

This study employed a quasi-experimental design. A pretest and posttest was administered to both the two groups. The experimental group underwent an intervention where they learnt fractions using "wajeez Math Software, Common and Decimal fractions section "version 5" to teach fractions for two weeks, while the control group they learnt fractions using traditional chalk and talk method.

Two classes of Economics registered student were selected for this study, they were sixty seven students from different disciplines at College of Applied Professions at Palestine Polytechnic University. Their academic achievement were comparable as they were appointed to each class by zigzagging after they were streamed according to Pre-test examination result. Tow mutual groups was founded after making the Average for the two classes and three students were excluded. The result for the two classes in Table I below:

TABLE I. COMPOSITION OF SAMPLES

Group	*No of Std in Group*	*Percentage*	*Average for Pretest exam*
Experimental	32	50%	5.31
Control	32	50%	5.71
Total	64		

2. Research Procedure

This study took place at College of Applied Professions at Palestine Polytechnic University after these students had their first exam in the Economics class. The examination covered the subject of elasticity of demand and supply, which is used fractions (Multiplication and Division), and the researchers found that they were struggled when they used fractions. They have learnt the fraction at school. Due to that, researchers has to teach them the concept of fractions. Both of the two groups sat for an achievement test on fractions which is called Pretest exam.

For the control group, it was used by teaching them how to solve the elasticity questions in the traditional way. Because researchers needed to refresh the concepts of fraction, and they have studied for examination.

The experimental group students were taken to the Computer laboratory for three time for one week, with one work hour. The researchers teach the student the concept of fractions by using the software and by using the game in this software.

After that both the control group and experimental group sat for the achievement test that is called posttest exam.

3. Data Analysis

Statistical Package for the Social Sciences (SPSS) was used to answer the objectives of this study. Achievement test scores

were analyzed. The test was used to test for (Mean score, Students' knowledge of the elasticity law, The correct application of the elasticity law, and Error rate in fractions operations) between the pretest and posttest exam for the control group and experimental group

RESULTS

The results of this study are discussed in the following tables below:

TABLE II. Result of the pretest and posttest for the Control group

Statement	*Pretest*	*Posttest*
Mean score	5.31	5.56
Students' knowledge of the elasticity law	94%	94%
The correct application of the elasticity law	88%	94%
Error score in fraction operations	38%	34%

The Table II above showed that the control group obtained a mean score of 5.31 in pretest exam while they obtained 5.65 in posttest exam. And the students' knowledge of the elasticity law in pretest and posttest are equal with 94%. The students application for the elasticity law in pretest was 88% correct, while in posttest was 94%. Finally, the students hade error score in fraction operations in pretest 38%, and 34% in posttest. This means that there has been an improvement in student achievements after the posttest exam.

TABLE III: Result of the Independent t-test on the pretest of both groups

Group	*N*	*Mean*	*Std. Deviation*	*T*	*Sig. (2 Tailed)*
Control	32	5.31	1.71	0.834	0.407
Experimental	32	5.71	2.15		

Table III above showed that the control group obtained a mean score with 5.31, while the experimental group obtained a mean score of 5.71. The t value was 0.834, However the p-value was not significant with a p-value of 0.407 ($p<0.05$). This results indicate that we accept the null hypothesis (there is no difference between mean grades for the control and experimental group), in other words, we accept the alternative hypothesis (there is no difference between mean grades for the two groups). Making another exam using the same teaching methods do not affect the results of the students.

TABLE IV: Result of the pretest and posttest for the experimental group

Statement	*Pretest*	*Posttest*
Mean score	5.71	6.34
Students' knowledge of the elasticity law	93%	96%
The correct application of the elasticity law	90%	96%
Error score in fraction operations	40%	31%

The Table IV above showed that the experimental group obtained a mean score of 5.71 in pretest exam while they obtained 6.34 in posttest exam. And the students' knowledge of the elasticity law in pretest was 93%, and 96% in posttest. The students application for the elasticity law in pretest was 90% correct, while in posttest was 96%. Finally, the students hade error score in fraction operations in pretest 40%, and 31% in posttest. The results above showed that there is improvement in student achievement after the posttest exam.

TABLE V: Result of the Independent t-test on the posttest of both groups

Group	*N*	*Mean*	*Std. Deviation*	*T*	*Sig. (2 Tailed)*
Control	32	5.56	1.58	2.05	0.044
Experimental	32	6.34	1.45		

Table V above showed that the control group obtained a mean score with 5.56, while the experimental group obtained a mean score of 6.34. The t value was 2.05, However the p-value was significant with a p-value of 0.044 ($p<0.05$). This results indicate that we reject the null hypothesis (There is no difference between the mean grades for the two groups). This means that the difference in the man score of both two groups was significant. This independent sample t-test was done to examine whether any significant differences exist between the posttest mean score of both the Control and Experimental group.

Findings from this study showed that the experimental group improvement is higher than the control group. The mean score after the posttest for experimental group was 6.18 while in control group was 5.65. Error score in fractions operations in posttest for experimental group was decreased from 40% to 31%, while in control group was decreased from 38% to 34%. This means that there was big improvement in experimental group in using the fractions and this thing appeared when dropped in the use of fractures by 9%, while in control group dropped by 4%.

Finding from this study also showed that the student problems was not due to the concept of elasticity when both of the two groups have high knowledge in elasticity law before and after using pretest and posttest exam. On the other hands, both the two groups have applied correctly on the use of elasticity law.

DISCUSSIONS

Based on the researchers theory, which states that the weakness of the students in the Economic course signs is due to the weakness in the fractions, and not because of their lack of understating of Economic Concepts.

fraction instruction beginning in elementary school, many people fail to gain a firm understanding of fractions and harbor misconceptions through high school and college [9].

The studies about fractions have identified many misconceptions of students. The main reason for these misconceptions is that, in the teaching of fractions, one early passes to operations and numerical representations without understanding the important elements of fractions such as dividing whole into equal parts, identifying unit, unitizing and re-unitizing etc [12]. Therefore, it is clear that if we want to

enrich students' understanding of fractions and to help them overcoming their misconceptions, we should foremost start by overcoming the shortcomings of student teachers in this subject [4].

Fractions can be considered as one of the most important concepts that student must master in school level and also in college level. However, simple misleading methods taught by teachers or misconceptions develop by the students themselves will jeopardize their perception toward mathematics in later stages [21]. Furthermore, These findings are encouraging and suggest that ICT-based learning activities are well-accepted by students. And this finding support previous studies to show that using technology in learning does give positive impact in constructing students understanding of any discipline and one of them are fractions.

This study was done to support the vision of Palestine Polytechnic University of the shift towards enterprising learning, These results support and stimulate university staff to shift towards enterprising learning, and the need to use technology in the teaching of all disciplines operations. with the possibility of cooperation with other universities in order to deepen the idea of enterprising learning, even more than of academic achievement for students.

CONCLUSION

The finding of this study showed that using computer software in learning fraction has been effective. This was shown through the improved in (Mean score, fraction error rate) of the experimental students group. Experimental group performed better when using the Software than control group that used the traditional teaching method. In addition, using software enhanced the concepts of fraction understanding for experimental group.

All students take a math course at the college, which is a compulsory course. I advise the college to give this course to the students before the economics course, or to be in conjunction with it, and also to use this Software or other similar Software to teach mathematics through the use of enterprising learning .

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REFERENCES

[1] A. Shittu. N. A. and Shittu, A. J. K, "Critical issues in evaluating education technology," 47-58. doi: 10.4018/978-1-60960-015-0.ch004, 2011

[2] A. Katmad, A. Mavidis and T. Tsiatosos," Implementing Gave for Supporting Learning in Mathematics", The Electronic Journal of e-Learning Volume 12, (230-242), Issue 3 2014, available online at www.ejel.org

[3] A.J. Grillo, A.D Latif, and K.S Stole, "The relationship between preadmission indicators and basic math skills at a new school of pharmacy," The annals of pharmacotherapy, 35 (2), 167-172, 2001.

[4] B. Savas, "Primary Studetn Teachers' perspectives of the Teaching of Fractions," Acta Didatica Napcensia, Volume 9, Number 1, 2016.

[5] E. Pacetti,"Improving the quality of education in Palestine through e-Learning and ICT: the bottom-up approach for a sustainable pedagogy", University of Bologna, Bologna, Italy, January 2008.

[6] Electronic Journal of Mathematics and Technology, Volume 3, Number 1, ISSN 1933-2823.

[7] G. Booker, "Children's construction of initial fraction concepts," In A. Olivier A k. Newstead (Eds.), (Vol. 2, pp. 128-135). Stellenbosch, South Africa: Program Committee of the 22th PME Conference, 1998.

[8] J.R Murnane, B.J, Willet, and F. Levy, "The growing importance of cognitive skills in wage determination. Review of Economics and Statistics, 77(2), 251-266, 1995.

[9] K. Fazio, "Casey A, Siegler. Rober S, Improving Children's Knowledge of Fraction Magnitudes, PLOS One \DOI:10.1371/Jornal.pone.0165243, 2016.

[10] M.G. Lioyd, and M. Wilson, "Supporting innovation: The impact of a teacher's conceptions of functions on his implementation of a reform curriculum," Journal for Research in Mathematics Education, 29(3), 248-274, 1998.

[11] Ministry of Education, Taipei, Taiwan, 2008.

[12] N. Bezuk, and M. Bieck, "Current research on rational numbers and common fractions: Summary and implications for teachers. In D.T. Owens (Ed.), Research ideas for the classroomMiddle grades mathematics, 118-136. New York:Macmillan. (1993).

[13] N.Wahbeh,"ICT and Education in Palestine: Social and Educational Inequalities in Access to ICT. A Case Study Approach. A.M. Quattan Fundation, 2006.

[14] National Assessment of Educational Progress 2001, Retrieved September 2008 from http://www.doe.k12.ga.us/sla/ret/naep.htm

[15] P. Groff, "Is teaching fractions a waste of time?" Clearing house, 69, 177-179, 1996.

[16] P. Lena, A.Tobias, D.Ylva, H. Magnus, and G.Agneta, "A Teachable-Agent Arithmetic Game's effects on Mathematics Understanding, Attitude and Self-Efficacy', Proceedings of the 15th International Conference on Artificial Intelligence in Education, Auckland, , Lecture Notes in Computer Science, Volume 6738, pp. 247-255, New Zealand, 2011.

[17] Palestine Polytechnic Universtiy, "Progression Towards an Entrepreneurial University Model, by Van Morar, Nuffic NFP-TMT Project, Maastricht School of Management, 2014.

[18] R. Judy, and H. Chathrin,"Computer game design: Opportunities for successful learning", ScienceDirect, Computer & Education 50 (2008) 559-578, 2007.

[19] R.jhon,"Student Achievement Effects of Technology-Supported Remediation of Understanding of Fractions, Paper presented at the annual meeting of the Canadian Society for the Study of Education, Ottawa, May 2009.

[20] S.Ed,"Does ICT contribute to powerful learning environments in primary education. Computers and Education, 44(3), 343–355, 2004.

[21] T.noorbaizura, E.Leon,"Effect of Student's Achivement in Fractions using GeoGebra", SAINSAB, Vol. 16, pp 97-106, ISSN 1511 5267, 2013.

[22] W. Ahmad, and N.H.B.A. Latih, "Development of a Mathematics courseware: Fractions, Proceedings of the Fifteenth Asian Technology Conference in Mathematics, Kuala Lumpur, Malaysia, 17-21 December 2010.