The Critical Thinking Abilities in Learning Using Elementary Algebra E-Books: A Case Study at Public Universities in Indonesia

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ABSTRACT

The learning Algebra courses are often taught using coventional textbooks. However, the reality of the learning outcomes has not been able to absorb the material to the maximum extent possible, and this is because the textbooks is limited in number so that students only record some of what is taught by the Lecturer. At the same time, electronic books are available free of charge in several world libraries. The purpose of this study is to determine the ability to think critically mathematically through the use of Elementary Algebra electronic books. The study of the method are used a Quasi Experiment with a nonrandomized Pre-test Post-test Control Group Design research design. The study population was all students who took Elementary Algebra in the Department of Mathematics Education, Malikussaleh University, in the Even Semester 2018/2019 academic year. Sample for the study was students of class A1 as an Experiment group using E-books for Teaching, and Class A2 as a Control group with lectures using conventional textbooks. The results showed that the mathematical critical thinking ability of students taught using Electronic books was better than the mathematical critical thinking ability of students who were taught using conventional textbooks. Thus the use of elementary algebra electronic books (E-books) can improve students' mathematical critical thinking skills in learning Algebra.

1. INTRODUCTION

The development of science and technology now greatly affects all aspects of human life, especially in higher education (De Jong *et al.*, 2004). Higher education now has begun to apply to learn using the internet or called online learning or e-learning (Herrington, 2009). Likewise, learning sources or teaching resources that are used in universities have implemented electronic-based, both using online classes, electronic books (e-books), and interactions between videos (Smith, 2012). All this is due to the rapid development of the digital world.

In determining the learning model also depends on the media and type of books to be used by lecturers, lecturers must be able to apply learning models that are appropriate to the characteristics of students (Ogata *et al.*, 2017). Especially in the type of learning resources used, lecturers are required to teach following the latest technological developments (Grant, JM (2004). This rate of development will facilitate the learning system built in a tertiary institution by providing easy internet access (Olsen *et al.*, 2013). Students are given adequate internet access so that they can learn through online classes, virtually, face-to-face does not have to meet directly with lecturers, students can learn through e-books available in digital libraries (Ciampa, K. (2012). Lecturers only provide instructions learning, assessment, and other technical aspects so that students are guided in learning (Appleton, L. (2005b).

The availability of e-books in various digital libraries has a positive impact on the progress of science in other parts of the world, as implemented by lecturers in European countries in online meetings with students, online distance learning courses, students are forged to study independently without must meet face to face (Korat, O., & Shamir, A. (2012). Laptops, computers, and mobile devices are tools used to be able to explore learning resources that are available for free in digital book libraries (Nie, 2011). Students can easily download e-books quickly and use them to learn via laptop, computer, or mobile.

An e-book is a type of electronic book that can only be read digitally on a computer screen, a particular e-book reader, personal digital assistant (PDA), or even a cellphone (Nelson, 2008). E-books are e-content based learning object types whose benefits can include: hyperlinking, nonlinearity, data density, adjustment capabilities, greater distribution, low cost, search capabilities, and other multimedia features (Shiratuddin, Hassan, & Landoni, 2003). Buzzetto *et al.* (2007) explained that e-books were introduced in the late 1990s, the slow pace of e-book growth. E-books are believed to have come to change the way we understand reading and represent the future of reading in this digital age; critics explain that reading on screen is an unpleasant experience that has, and will continue to, inhibit e-book growth (Weeks, 2002). According to Prensky (2001), the generation entering tertiary education, "Millennials," is

fascinated by new technology and considers it a natural part of their environment. This paper is the findings of students' reported experiences and perceptions of e-books at a historically Black university. In other words, e-books are consumed on the screen rather than on paper, which provides easy access to readers by using a laptop, computer, or mobile or called m-learning.

According to Nelson (2018), campuses become the most important market place in using e-books. The results of study by Woody *et al.* (2010) showed that the experience of reading e-books is not equivalent to reading textbooks. Also, according to Moody's (2010) findings, the use of electronic books in classrooms is a growing trend. Educators are interested in using reading technology to support emerging young readers, especially those who are at risk for reading failure. Besides, the use of e-books provides evidence of positive experience as a source of electronic information (Appleton, 2004a).

The results of study by Kissinger (2013) provides conclusions in using e-books (1) students express competence in the use of their mobile e-books, (2) students showed a feeling of high self-efficacy when using cellular e-books, (3) students value their use mobile e-books for their learning, (4) students individually and metacognitive in their learning with mobile e-books, (5) students enhance their learning socially and in existing learning opportunities, and (6) students and students. Instructors have different views about the value and usefulness of interactive social textbooks. Besides, using e-books can support understanding (Zucker *et al.*, 2009). Viewed from the ability to read, the use of e-books can also improve children's literacy skills comprehensively (Grimshaw *et al.*, 2007). Thus the use of learning resources from e-books can make it easier for students to learn and understand the material independently, especially in learning mathematics.

Algebra is one of the subjects taught in higher education, especially in the Department of Mathematics Education. Algebra textbooks are very often found in digital libraries on the internet, both provided free and commercially. Textbooks available in digital libraries are versions of books in PDF format or often referred to as one of the e-books. According to Yager *et al.* (2011), teaching using e-books can improve students performance. For this reason, researchers are interested in using E-books in teaching Elementary Algebra for Students of the Department of Mathematics Education, at Malikussaleh University, Indonesia.

Malikussaleh University is one of the public universities that runs the Department of Mathematics Education, under the Faculty of Teachers Training and Education, where the department is still limited to books in the e-book version. Researchers believe that using this e-book will provide a different experience than using conventional textbooks. The Elementary Algebra e-book used by researchers is a book written by Jerome E. Kaufmann and Karen L. Schwitters, 9E Edition, with the title Elementary Algebra published in 2009.

The use of E-books on the Elementary Algebra subject is a transformation of learning in universities; at least it can build a new tradition for more dynamic learning resources. Like Blended Learning (Garrison, D. R., & Kanuka, H, 2004). The use of ICT in teaching mathematics will also have a significant impact on students' experience, at least using e-books in every subject (Porter *et al.,* 2014).

The critical thinking skills seen in this study after learning by using e-books are the abilities of students who are built or formed in the learning process by using e-books. Students who have this ability will be able to understand and analyze the

material well. Therefore, researchers are interested in doing this study further to find out the increase and differences in the ability to think critically using algebra e-books and conventional books, the reason being that as far as existing literature studies, there is no research that explains in detail the issue.

2. RESEARCH METHOD

This type of research used in this research is quantitative research with quasi-experimental methods. Learning is divided into two types, namely learning using elementary algebra e-books and learning using conventional books. This study uses a Nonrandomized Pretest Posttest Control Group Design research design.

Table 1. Design Research design patterns

Group	Pre-test	Treatment	Post-test
Experiment	X1	X	X2
Control	X1	-	X2

The study population was all students who took Elementary Algebra in the Department of Mathematics Education, Malikussaleh University, in the Even Semester 2018/2019 academic year. While the sample for the study was students of class A1 as an Experiment group using Electronic Teaching books, and Class A2 as a Control group with lectures using conventional physical textbooks. This research was conducted in February - March 2019.

The test instrument used in this study is a test item to measure the ability to think critically mathematically, which consists of 4 items of essays given in the form of pretest and post-test. The ability to think critically mathematically will be measured in the form of the ability to identify problems, take steps to solve, clarify a statement, and make conclusions. This critical thinking ability has been tested by Martiana (2015) in her unique study in learning mathematics.

The data analysis technique used in this study uses a non-parametric test that is the Mann-Whitney test assisted by SPSS 18 Software program.

3.   RESULTS AND DISCUSSION

The data used to calculate the increase in students' mathematical critical thinking skills is the N-gain value data.

Results

The following is a table that illustrates the pretest, posttest, and normalized gain (N-gain) descriptive data for tests of mathematical critical thinking ability.

Based on table 2, it can be seen that the difference in the average value of the pretest of the experimental class is greater than the average value of the control class pretest, this shows that the score of students' mathematical critical thinking ability applied using the Problem Solving method is more varied and spreads on the class average. The data used to calculate the increase in students' mathematical critical thinking skills is the n-gain value data.

Based on Figure 1, the N-gain value of the experimental class is 0.83, while that of the control class is 0.76. The results of this study indicate that the use of Algebra Elementary E-books shows an increase in students' mathematical critical thinking skills.

Table 2. Score of the Mathematical Critical Thinking Ability

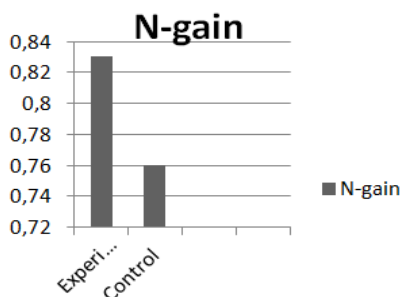| Abilities	Score	Experiment				Control			
		n	$\bar{x}$	s	%	N	$\bar{x}$	S	%
Critical thinking	Pretest	30	4,42	1,84	0,38	28	4,31	2,46	0,38
	Post-test	30	11.64	1,68	0,86	28	9,41	2,58	0,64
	N-gain	30	0,83	0,18		28	0,76	0,27	
Maximum Score = 12									

Figure 1. N-Gain Score of Mathematical Critical Thinking Ability

The normality test aims to test whether the data obtained has a normal distribution or not. The n-gain score normality test in this study uses the Shapiro-Wilk technique where the sig value. (p-value) < α (α = 0.05), then H0 is rejected and if the value of sig. (p-value) ≥ α (α = 0.05), then H0 is accepted.

Table 3. Normality Test Results Data for N-gain of the Critical Thinking Ability

Class	Shapiro-Wilk			Conclusion
	Statistics	Df	Sig.	
Experiment	0,784	30	0,001	Rejected H_0
Control	0,866	28	0,072	Rejected H_a

Based on the Table 3 above, it can be seen that the N-gain score of the mathematical critical thinking ability of the experimental class students has a Sig. < α = 0.05 so H0 is rejected. This shows that the N-gain score data of mathematical critical thinking ability of experimental class students are not normally distributed, while the N-gain score of mathematical critical thinking ability of control class students has a Sig. > α = 0.05, so Ha is rejected. This shows that the N-gain score data of mathematical critical thinking ability of control class students are normally distributed.

Based on the results obtained from the normality test of students' mathematical critical thinking abilities, one class of n-gain values is not normally distributed then it is continued with the non-parametric test, namely the Mann-Whitney test.

Table 4. Data of Non-Parametric Test Result

Statistics	Value	Conclusion
Mann-Whitney U	235,000	Rejected H0
Asymp. Sig. (2-tailed)	0.009	

Based on Table 4, it can be seen that the value of Sig. < α = 0.05, so H0 is rejected. That is, there is an increase in mathematical critical thinking skills that are taught using the Elementary Algebra E-book, and better than the mathematical critical thinking skills of students who are taught by using conventional textbooks significantly.

Discussion

The results showed that the mathematical critical thinking ability of the experimental class was higher than the mathematical critical thinking ability of students in the control class. This shows that students in the experimental class have higher mathematical critical thinking skills compared to the control class.

The ability to think critically in learning in the experimental class has increased. This can be seen from the answers of students in analyzing the case problems given to them through learning using the Algebra Elementary E-book. Students are taught using digital learning resources, where students can learn independently by using their computer screens, laptops, and mobile wherever and whenever. Besides, students are given mathematical assignments through the e-book.

By using Algebra Elementary E-books in small groups, students are guided through analyzing existing problems with their thinking skills. It is expected that with the increased ability to think critically, students can use to analyze the issues that occur in the surrounding environment. This shows that students in the experimental class have higher mathematical critical thinking skills than the control class.

Based on the findings in the Algebra Elementary subject learning, the use of E-books on the subject is a transformation in college, and this can build a new tradition for learning resources that are more dynamic, independent and inexpensive. Like Blended Learning, ICT, and other multimedia, e-books become one of the learning resources that are easily obtained digitally (Garrison, D. R., & Kanuka, H, 2004). The use of ICT in teaching mathematics will also have a significant impact on students' experience, at least using e-books in each subject (Porter *et al.*, 2014).

The critical thinking skills seen in this study after learning by using e-books are the abilities of students who are built or formed in the learning process by using e-books. Students who have this ability will be able to understand and analyze the material well. Therefore, the results of data analysis can be seen that the value of Sig. < α = 0.05, so H0 is rejected. That is, there is an increase in mathematical critical thinking skills that are taught using the Elementary Algebra E-book, and better than the mathematical critical thinking skills of students who are taught by using conventional textbooks significantly.

Mathematical critical thinking skills of students can also be seen from the average value obtained during the learning process. In the experimental class, the average values of N-gain obtained by students are 0.83, while in the control class, the average values of N-gain obtained by students are 0.76. This finding can be interpreted that the use of E-books in lectures on the subject Elementary Algebra in the Department of Mathematics Education, Malikussaleh University, Indonesia received excellent responses from students and improved the ability to think critically mathematically. This is in line with the results of research by Yager *et al.*, (2011) that teaching using e-books can improve student performance. Besides, using

e-books can support understanding (Zucker *et al.*, 2009). Viewed from the ability to read, the use of e-books can also improve children's literacy skills comprehensively (Grimshaw *et al.*, 2007). Thus the purpose of learning resources from e-books can make it easier for students to learn to understand the material independently, especially in learning mathematics.

4. CONCLUSION

Based on the results of study conducted it can be concluded that there is an increase in mathematical critical thinking skills taught by using Elementary Algebra E-book, and better than the mathematical critical thinking abilities of students who are taught by using conventional textbooks significantly, or in other words that students 'mathematical critical thinking skills using Algebra Elementary E-books are higher than students' mathematical critical thinking abilities that are given conventional textbooks. Thus the use of learning resources from e-books can make it easier for students to learn to understand the material independently, especially in learning mathematics.

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