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Research Article

The effect of an e-learning-based remedial program on students' learning outcomes: The case of Fraction

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ABSTRACT

Students experienced difficulty in studying the topic of fraction during the covid-19 pandemic resulted in incomplete learning so remedial learning was necessary. So far, remedial learning has not been optimally implemented. Therefore, to achieve optimal remedial learning objectives, e-learning based remedial learning is needed. The aims of this study were 1) to find out the effect of e-learning-based remedial learning on the topic of fraction on learning outcomes in junior high schools in Banda Aceh, 2) to examine the improvement in student learning outcomes through e-learning based remedial learning on the topic of fraction on learning outcomes in junior high schools in Banda Aceh. This experimental study used quantitative approach. This study was designed following the pre-experimental design using one-group pretest-posttest. One-group pretest-posttest is a design that includes a pretest followed by treatment and a posttest for one group. The population of this study was all eighth grade students in Banda Aceh. The sample was randomly selected. They were the eighth grade students at four junior high schools whose pretest scores had not yet reached the KKM score of 60. The instruments used were diagnostic test questions and remedial questions on the topic of fraction. Diagnostic and remedial test results data were analyzed with SPSS. The results shows that there is a significant effect of e-learning based remedial learning on the topic of fraction on learning outcomes in junior high schools in Banda Aceh, 2) e-learning based remedial learning on the topic of fraction improves the students' learning outcomes. The implication of this research is that teachers can implement the remedial learning based on e-learning on other learning topics, so that they has alternative solutions to the problem of implementing remedial learning outside of mathematics learning.

Keywords: Remedial Learning; E-learning; Learning outcomes;

1. INTRODUCTION

The covid-19 pandemic has disrupted the educational process. This disruption has a negative impact on students in certain classes or vulnerable sub-groups, especially in terms of students' academic and social-emotional development (Santibañez & Guarino, 2021). This is due to attendance at school with its problems (Gottfried, Kirksey, & Fletcher, 2022). Engzell, Frey and Verhagen (2021) state that during the pandemic students have made little or no visible progress for learning from home and longer school closures has put a heavy toll on countries with weak infrastructure. Learning loss is estimated to affect millions of children who have dropped out of school due to the current COVID-19 pandemic. Furthermore, Sabates, Carter and Stern (2021) state that the average learning loss is 66% of the previous learning acquisition in basic arithmetic. This widening gap in learning loss is due to lack of support for implementing learning at home and lack of learning resources that can be used at home (Sabates, Carter, & Stern, 2021), fewer time for learning (Schult, et al., 2022), lack of students' participation, and family status from a socio-economic backgound as well as their lack of collaboration with teachers, limited application of teachers' methods in teaching mathematics (Haser, Doğan, & Erhan, 2022), difficulties in the new learning environment such as distance learning (Schult, et al., 2022) which generally limits the ability of teachers and students for online learning (Mailizar, Abdulsalam, & Suci, 2020). So that in general students learning process in mathematics are not complete. This is in line with Davidson (2016) stating that mathematics is a subject that in general require remedial learning, where most remedial students have never passed the class.

Remedial learning is a program provided by educational institutions to help students who are not ready to strengthen their basic abilities (Zhao, Wang, & Liu, 2021), meet the needs of students who cannot follow the learning process in normal classes (Selvarajan, 2022), for students who do not demonstrate adequate knowledge in evaluation tests (Myllykoski, 2016), to help students who do not understand or who have been overlooked due to absence (Gordon, 2021), to understand learning difficulties, to overcome difficulties by improving their own way of learning and learning attitudes

which can encourage the achievement of optimal learning outcomes (Ministry of Education and Culture, 2016). In remedial learning, teachers can apply methods that vary according to the nature, type, and background of learning difficulties experienced by students, using learning media that can make it easier for students to understand basic competencies that are considered difficult (Kemendikbud, 2016). In fact, in general, remedial learning carried out by teachers in Aceh only limited to assignments or questions on topics that students have not completed without conducting further guidance (Sasalia, 2020), without applying methods that vary according to the nature, type, and background of learning difficulties experienced by students, and without using learning media that can make it easier for students to understand the basic competencies that are considered difficult (Apriliani, Sudiana, & Wiratini, 2019).

Fraction is regarded as a difficult topic by seventh grade students of junior high school. They were having difficulties in utilizing concepts and principles, difficulties in solving verbal problems (Dewi, Untu, & Dimpudus, 2020), difficulties in rewriting known problem components, applying the concept of calculating fraction operations, changing mixed fractions into ordinary fractions and vice versa, converting integers into fractions, and sorting fractions (Fitri & Prahmana, 2019). Failure in accomplishing standard objective on the fraction material in class and learning loss caused by the covid-19 pandemic require teachers to do remedial learning. So far, remediating difficulties for students has only been performed during lessons. This was cause by scheduling conflict since afternoon was set for the extracurricular activities, preparing and organizing administration such as learning tools (Chimhenga & Chitsa, 2016), other teachers doing remedial learning and unexpected break (Hermawati, 2018).

Many of the previous studies related to this problem mentioned that remedial learning activities that have been carried out so far were not optimal. Therefore it is necessary to implement remedial based on e-learning. E-learning during the Covid-19 pandemic has become a trend (Resta, Halim, & Huda, 2020). It was performed through digital platforms to ensure that learning activities are effective (Santoso, 2020). E-learning is a learning process using the internet or technology which is also a learning approach strategy to improve the learning process as a new solution to technological developments (Hammond, Zielezinski & Goldman, 2014), which aims to support the learning process either as a complement, additional or a substitute (Dewi, et al., 2021). E-learning has a broad reach, students can access e-learning easily as long as they have a registered account (Sutini, et al., 2020). Schools can take advantage of this technology to make learning faster, cheaper, and more effective (Tan, 2013). So it can be said that remedial learning based on e-learning gives the impression for students to study anywhere, anytime and offers a different level of interactivity from traditional learning approaches (Alshammari, 2019).

Dai and Huang (2015) stated that of the three remedial models investigated, the e-learning remedial instruction model was the most effective model than those of the remedial blended learning instruction model and the traditional instruction model for vocational students. Agasisti, Azzone, and Soncin (2021) stated that the use of Massive Open Online Courses (MOOCs) is effective in terms of student achievement in the context of formal education in physics remedial. Lutfiyah and Sulisawati (2019) explained that the e-learning media used in mathematics learning is categorized as effective, Supraptono and Utami (2016) also mentioned that the implementation of the web-based Intelligent Tutoring System remedial learning model to topic about formulas and functions is effective.The development of E-learning based remedial learning are already exist in Indonesia, namely the remedial project designed by Sasalia (2020). The use of remedial project learning in high school improves student learning outcomes, where the average remedial score of students is 75.81 while the previous was 55.81.

The remedial program developed by sasalia (2020) was further developed for broader needs by the Team of the Center for Research and Development of Indonesian Realistic Mathematics Education (PRP-PMRI) at Syiah Kuala University. The remedial program can be accessed via http://prp-pmri.unsyiah.ac.id/getmath. Based on the description above, this research aims 1) to find out the effect of e-learning based remedial learning on the topic of fraction on learning outcomes in junior high school in Banda Aceh, 2) to examine the improvement in student learning outcomes through e-learning-based remedial learning on the topic of fraction on learning outcomes in junior high school in Banda Aceh.

2. RESEARCH METHOD

This experimental study used quantitative approach. This study was designed following the pre-experiment design using one-group pretest-posttest. One-group pretest-posttest is a design that includes a pretest followed by treatment and a posttest for one group. The characteristic for the research sample was students whose diagnostic test score on the topic of fraction has not reached the national KKM score of 60. The participants' diagnostic and remedial tests at six junior high schools in Banda Aceh City were included in **Table 1**.

There were two variables in this study, namely remedial learning based on e-learning as the independent variable and student learning outcomes as the dependent variable. There were three instruments used in this study, namely: 1) A list of 10 multiple choice diagnostic questions to identify student difficulties, 2) three parts of remedial questions in which each part composed of 10 multiple choice questions to examine students' abilities following the remedial learning based on e-learning. The data were analyzed with the help of the Microsoft Office Excel program and Software Statistical Package for the Social Science (SPSS). This study aims to improve students' learning outcomes. The data were collected from: 1) the pretest data of the diagnostic test results for students' abilities in fraction numbers before the treatment, 2) the post-test

data of students' test results following the remedial learning based on e-learning on fraction numbers material. The data was obtained from http://prp-pmri.unsyiah.ac.id/getmath

Table 1. Number of Diagnostic Test Participants, Completed Diagnostic and Remedial Tests

No.	School Name	Number of Participants		
		Diagnostic	Complete	Remedial
1	School A	28	4	24
2	School B	32	14	18
3	School C	27	2	25
4	School D	22	3	19
5	School E	30	4	26
6	School F	22	2	20
	Total	161	29	132

Before calculating the N-gain, the researcher conducted a normality test from both the pretest and the posttest data. The normality test is used to determine whether the data is normally distributed or not (Supardi, 2016). This test was carried out using the SPSS Shapiro-Wilk normality test with a significant level of $\alpha = 0.05$. A non-parametric test, also known as the paired samples t-test in SPSS, was used for data that was not normally distributed. A non-parametric test, namely Wilcoson test in which known as the 2 related sample t-test in SPSS, was used for data that was not normally distributed. Whereas, the paired samples t-test was used for a normally distributed data. Next, the n-gain can be used to find out the increase in student learning outcomes.

The n-gain score can be calculated using Microsoft Excel based on the Metlzer formula (2007):

$$\text{N-Gains} = \frac{\text{Posttest Score} - \text{pretest score}}{\text{Maksimum Score} - \text{pretest score}}$$

3. RESULTS AND DISCUSSION

3.1. Results

The percentage of participants who passed the initial and remedial tests of the diagnostic tests results can be seen in **Table 2.**

Table 2. Number and Percentage of Diagnostic Test Participants, Completed Diagnostic Test and Remedial Tests

No	School Name	Number of Participants		
		Diagnostic	Complete (%)	Remedial (%)
1	School A	28	15.00	85.71
2	School B	32	43,20	56,25
3	School C	27	7,41	92.59
4	School D	22	13.64	86.36
5	School E	30	13,44	86,66
6	School F	22	8.70	91.90
	Total	161	18.02	81.98

Based on **Table 2**, the lowest percentage of remedial students was 85.71%, namely in School B. Meanwhile, the total number of students in the six schools was 81.98%. This shows that both the number of students per school and the total number of students in the six schools were in need of remedial learning on fraction numbers material. Furthermore, a normality test was carried out before testing the hypothesis. Data from the normality test from SPSS were presented in Table 3.

Table 3. Normality Test Results

No.	School Name	Test Type	Shapiro-Wilk		
			Statistics	Df	Sig.
1	School A	Diagnostic	0.925	24	0.076
		Remedial	0.943	24	0.191
2	School B	Diagnostic	0892	18	0.041
		Remedial	0.846	18	0.007
3	School C	Diagnostic	0.927	25	0.075
		Remedial	0937	25	0.128

4	School D	Diagnostic	0.903	19	0.055
		Remedial	0.909	19	0.071
5	School E	Diagnostic	0.899	26	0.015
		Remedial	0.949	26	0.217
6	School F	Diagnostic	0.916	20	0.083
		Remedial	0.932	20	0.172

Based on **Table 3**, it shows that there are two schools in which H0 was rejected, namely Schools B and E, meaning that the data from these two schools were not normally distributed. While the data from four other schools, namely Schools A, C, D and F, were normally distributed which mean that the H0 was accepted. Next, a hypothesis test was carried out. A non-parametric test, namely Wilcoson test in which known as the 2 related sample t-test in SPSS, was used for data that was not normally distributed. Whereas, the paired samples t-test was used for a normally distributed data. The non-parametric test data is as shown in **Table 4.**

Table 4. Non-Parametric 2-Related Sample t-test Results

	Remedial Tests - Diagnostic Tests	
	School B	School E
Z	-3.894[b]	-4.199[b]
asymp. Sig. (2-tailed)	0.000	0.000

Based on **Table 4**, the Asymp. Sig. (2-tailed) of both schools is 0.000. This indicates that the Asymp. Sig. (2-tailed) has a sig value < 0.05, meaning that the data has a significant effect on e-learning based remedial learning on learning outcomes.

Table 5. Parametric Paired-Samples t-test Results

No	School Name	Paired-Samples t-test		
		t-test	Df	sig. (2 -tailed)
1	School A	-12.294	23	0.000
2	School C	-8.247	24	0.000
3	School D	-6.852	18	0.000
4	School F	-6.019	19	0.000

Based on **Table 5**, the Sig. (2-tailed) of the other four schools is 0.000. It shows that the value of sig. (2-tailed) has a sig value < 0.05, meaning that the data has a significant effect on e-learning based remedial learning on learning outcomes.

Table 6. Average Value Results, N-gain

No.	School Name	Test Type	Mark			N-Gain
			Min.	Max.	Average	
1	School A	Diagnostic	10	50	29.58	0.66
		Remedial	50	100	76.67	
2	School B	Diagnostic	10	50	32.78	0.62
		Remedial	40	100	76.11	
3	School C	Diagnostic	0	50	23.20	0.57
		Remedial	30	100	68.40	
4	School D	Diagnostic	0	50	28.95	0.57
		Remedial	10	100	71.05	
5	School E	Diagnostic	0	50	25.77	0.44
		Remedial	30	90	60.77	
6	School F	Diagnostic	10	50	33.50	0.36
		Remedial	30	90	58.00	

Based on **Table 6**, all six schools experienced an increase in terms of min, max.and average value. Judging from the n-gain scores of school A, B, C, D, E, F respectively, they are in the medium category.

3.2. Discussion

Before carrying out remedial learning based on e-learning, researchers first conducted a diagnostic test for six junior high schools in Banda Aceh so that the indicators of student difficulties can be identified. Based on the diagnostic results it was

found that the percentage of students who did not pass the passing grade score in the six junior high schools in Banda Aceh City are as follow School A 85.71%, School B 56.25%, School C 92.59%, School D 86.36%, School E 86.66%, and School F 91.90%. According to the Ministry of Education and Culture (2017), if students take part in remedial program, then remedial learning was conducted by providing learning with different methods and media. Thus, remedial learning based on e-learning was carried out by providing learning materials and videos for each question.

The results showed that the n-gain value of the students' abilities in fraction for School A was 0.66, School B was 0.62, School C was 0.57, School D was 0.57%, School E was 0.44, and School F of 0.36. The scores for all schools studied were in the n-gain interval group of $0.3 < g < 0.7$ which falls under moderate criteria. Therefore, based on the results of the average n-gain test of remedial learning in each school, it shows that there was an increase in learning outcomes. Prasetyo, Supraptono and Utami (2016) explained that web-based remedial learning can improve learning outcomes in terms of n-gain. Differences in n-gain values of student learning outcomes in each school is caused by many factors, including limited research time, lack of motivation to learn mathematics (Dharmamurti & Murwaningtyas, 2012), and disorientation problems (Chen, 2011).

Diagnostic tests on remedial learning based on e-learning can be accessed repeatedly at anytime and anywhere by the students before they take part in the program. Mainly because the program provides a discussion of each problem so that students can find out the difficulties they experienced and learn it over again. Apart from that, when remedial learning based on e-learning takes place, students are given learning opportunities to study the materials and learning videos twice. By giving stimulus through remedial learning based on e-learning, students will respond. This stimulus-response relationship will lead to automatic habits in learning. With exercises, the relationship is getting stronger (Hamalik, 2011) that exercises can improve the student's stimulus-response relationship.

In addition, remedial learning based on e-learning is designed to be as simple as possible so that it is easy to utilize. Thus it will help students begin the learning program and give satisfaction to the user so as to strengthen stimulus-response relationships which in turn can improve learning outcomes. Prasetya and Harjanto (2020) explain that there is an effect of online learning quality on learning outcomes so that the variables of this quality and the level of satisfaction contribute to the influence on learning outcomes. Therefore, this remedial learning gives the impression of being able to re-understand topic that has been studied in the past (Slamet, 2015).

Based on the hypothesis to see the effect of e-learning based remedial learning on the topic of fraction on learning outcomes in junior high school in Banda Aceh, it was found that there are six schools with a Sig. (2-tailed) is 0.000. It shows that there is a significant effect of e-learning based remedial learning on the topic of fraction on learning outcomes in junior high school in Banda Aceh. Based on the discussion above, the common limitations face by teachers on why remedial learning has not been implemented optimally so far are related with scheduling conflict, mainly the extracurricular schedule (Apriliani, Sudiana, & Wiratini, 2019), preparing and organizing administration such as learning tools (Chimhenga & Chitsa, 2016), other teachers doing remedial learning and unexpected break (Hermawati, 2018), the learning environment is not conducive and the lack of school administrator support (Kasran, Toran, & Amin, 2012). E-learning based remedial learning help to overcome these problems.

4. CONCLUSION

Based on the results of the study it was concluded that: **1)**. Based on the hypothesis testing over the six schools obtained a sig. (2 tailed) of 0.000. It can be concluded that there is a significant effect of e-learning based remedial learning on the topic of fraction number on learning outcomes in junior high schools in Banda Aceh. **2)**. Based on the test results, the n-gain value of students at schools A, B, C, D, E, F were 0.66, 0.62, 0.57, 0.57, 0, 40 and 0.42 respectively. Therefore, the results of remedial learning based on e-learning from the six schools are in the moderate category. It can be concluded that remedial learning based on e-learning on the topic of fraction can improve students' learning outcomes in junior high schools in Banda Aceh.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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