Article

Effects of Micro-Lectures on Junior High School Students' Achievements and Learning Satisfaction in Mathematics Lessons

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Abstract: In recent years, using micro-lectures (a short video of less than ten minutes) as a digital learning medium has become popular for integrating technology into mathematics lessons, providing new experiences to students and helping them to master mathematical concepts. It is important to note that the effectiveness of a micro-lecture depends on how teachers use it and on students' perceptions of learning support media. Therefore, this research aims to determine Junior High School students' achievements and satisfaction using micro-lectures on the topic of Direct and Inverse Proportions. Teachers' micro-lectures in this research were designed based on their teaching styles, learning objectives, and considering the needs of their students. A quasi-experiment with 3, 2, and 1 pretest-posttest design with experimental and control groups was also used. In the first and second experimental groups, teachers used the same version of the micro-lectures in their classrooms as the main learning medium and at home to preview and review Direct and Inverse Proportions materials. At the same time, the control group used conventional expository learning activities. Finally, a learning satisfaction questionnaire was used to determine students' perceptions of using micro-lectures in their mathematics lessons. Findings indicate that the use of micro-lectures in the experimental classes I and II is better than in the control class and led to improved learning achievements and student satisfaction. Meanwhile, there is no significant difference between using micro-lectures inside and outside classrooms. Students' report cards also showed that their learning satisfaction using this technique was higher than the control class. Practical implications and suggestions for further investigation are to be also discussed at the end of the paper.

Keywords: micro-lectures; learning media; learning achievement; learning satisfaction; mathematics education; secondary education

MSC: 97F80

1. Introduction

Several technology-based learning media emerged after the COVID-19 pandemic in Indonesia that support online learning and act as an additional supplement to mathematics learning [1,2]. One of the various learning resources commonly used at the Junior High School level (including students from 12 to 15 years old) is the micro-lectures generated by mathematics teachers, which are uploaded to the YouTube platform [3,4]. This method has been used in many countries at various levels of education in the last decade and has also become one of the fun learning media in mathematics. However, it is not widely known and implemented in Indonesia, where the use of dynamic mathematics software,

such as GeoGebra [5] and geometer sketchpad [6], is more widely used at the Junior and Senior High School levels. OECD 2021 [7] data show that the use of technology-based learning media is indeed not maximal, and teachers are still unfamiliar with using it to teach mathematics lessons; rather, they still use teacher-centered methods and facilitate student learning activities by providing paper- and module-based exercises. Efforts are still needed to stimulate teachers to improve the implementation of technology in teaching and learning activities. From previous observations, there are many research and development papers on micro-lectures in Indonesia [8–10], with little information about the effect on student achievement, learning satisfaction, and how teachers use it. Therefore, further research is needed to observe more how mathematics teachers in Indonesia use micro-lectures and their ability to improve student achievement and learning satisfaction.

Over the last few years, research on micro-lectures and this teaching tool has been used at all levels of education [11–13]. A micro-lecture is a short video of not more than 10 min that aims to discuss one of the important topics in mathematics [14]. Micro-lectures tend to make the basic concepts of difficult materials easier for students to understand and improve their learning outcomes [15–17]. Teachers can use them to facilitate abstract learning. Previous studies on micro-lectures focused more on their development as a technology-based learning media [18,19]. Yang et al. [20] described the various types and how they are designed as a learning medium. After the COVID-19 pandemic, Kossen [21] pioneered micro-lectures to increase online class engagement by employing mixed methods. Another research reported its adoption in English lessons [22,23]. Meanwhile, few studies were conducted on its use in mathematics classes.

Based on this background, this research is designed to examine the effect of micro-lectures on student achievement and learning satisfaction. This micro-lecture was made by teachers on the topic of the direct and inverse proportion at the Junior High School level. The research questions are as follows:

- Is there a difference in student achievement in a class that uses micro-lectures and the expository method, an approach commonly used by mathematics teachers in Indonesia?
- Is there a difference in learning satisfaction in classes that use micro-lectures and expository methods?

To answer this question, the pre-test and post-test were used as a data collection technique to observe differences in the abilities of treatment and control classes. The research finding provided knowledge on the benefits of these technology-based mathematics learning media and their contribution to developing countries, including Indonesia. It also provided important information on ways for schools that use micro-lectures to improve students' achievement and support teaching and learning activities.

2. Literature Review

This literature review comprises four sections, namely the definition of micro-lectures, and how to design it. It also explains the effect of micro-lectures on mathematics learning outcomes and the importance of increasing student satisfaction. All explanations in the literature become basic information in this present research.

2.1. Definition of Micro-Lectures

Initially, a micro-lecture was defined as a short video with a duration of approximately 60 s created by Professor LeRoy A. McGrew [24]. David Penrose stated that its structure affected students who took regular classes for long working hours [25,26]. Three important elements have to be considered in creating micro-lectures, namely the opening of research objectives, explanations that focus on key concepts, and tasks that promote students to study related materials or activities. These will ensure that learning activities in the classroom are student-centered [27,28].

Over time, the duration of micro-lectures, which originally lasted for one minute, has been lengthened to approximately 8 to 15 min [17,29]. It is designed to take advantage of multimodal forms, and specifically aimed to study basic concepts, discuss difficult questions,

and explain learning activities and experiments [30,31]. Zhou [32] stated that micro-lectures refer to relatively short instructional videos that students can use to study independently.

2.2. Micro-Lectures Designing Strategy

In Indonesia, teachers can produce micro-lectures and ensure they are customized and designed to the learning objectives, students' conditions, and the adopted approach [33,34]. Several universities have ICT-based learning media development courses, one of which is micro-lectures. Furthermore, the government of each region often conducts training on how it is produced and utilized. Some of these micro-lectures are usually uploaded on Google and YouTube, including WhatsApp groups, making them easily accessible to many students.

There are several methods and strategies for making micro-lectures: these include assignments, problem-based learning approaches, cooperative investigations, feedback interactions, knowledge strengthening, experimental demonstrations, discussing objects in students' daily lives, and other procedures [35–37]. Mathematics teachers can flexibly select strategies or combine various methods when creating these videos. Furthermore, several approaches and tools can be used during production, such as digital and computerized cameras, smartphones, etc. Video animation involves using Flash, Premiere, and Corel software combined with Camtasia Studio.

Despite years of making good instructional courses and demonstrations, many schools prefer to use professional equipment for the production process [26,38]. However, experts do not always have to make micro-lectures for teaching and learning activities; rather, it tends to be more flexible when made by the mathematics teacher who ensures it suits students' needs and school characteristics. Each region has diverse characters that make micro-lectures unique [15,39]. Teachers can also include regional themes and cultures of their respective areas as an added value. Several studies reported that this technique positively affects students' mathematics learning outcomes [29,40].

Effects of Micro-lectures on Students' Mathematics Learning Outcomes:

The micro-lectures method creates opportunities to encourage students to learn independently and get new experiences with better learning outcomes [41–43]. This goal has been specifically designed in micro-lectures to provide short teaching activities around knowledge using a short video format [44]. Micro-lectures can be used to explain diverse mathematics materials and are employed at various educational levels [45]. This technique has certain advantages, such as increasing students' learning motivation [17,46], exploring basic principles, and visualizing abstract concepts that can effectively stimulate students' interest in studying mathematics [37]. Tommy et al. [3] succeeded in developing micro-lectures on linear programming material and proved that teachers' ability to employ this media also increases students' interest and changes their attitudes towards mathematics. Nevertheless, how teachers make micro-lectures and the way they use micro-lectures as learning media to support mathematics learning activities are important points for the successful implementation of micro-lectures.

To summarize the literature review, adopting micro-lectures to help students learn mathematics is a recent innovation that became popular after the COVID-19 pandemic. The diverse contents associated with several mathematical concepts tend to be promoted. The inclusion of video-based learning media in the curriculum is usually combined with various academic methods and approaches, such as online flipped classrooms and MOOC, which may benefit students at various levels of education. Tommy further stated that using micro-lectures generally provides maximum learning outcomes besides mathematics achievement.

2.3. Student Learning Satisfaction

Learning satisfaction is one of the topics often discussed in educational psychology over the past few decades [47,48]. This is because it is related to students' learning outcomes [49]. In mathematics education, those with low learning satisfaction have been associated with poor outcomes. However, this research measured learning satisfaction

using the ARCS model (Attention, Relevance, Confidence, and Satisfaction) [50,51]. Several factors affect it by applying a monotonous learning model in teaching and learning activities. Students cannot enjoy or follow mathematics lessons and begin to avoid solving related tasks. All these scenarios indicate that their learning satisfaction in mathematics is low [52]. Changes, specifically in learning strategies and media, should be adopted to increase students' learning satisfaction, thereby causing them to be more enthusiastic and actively participate in studying this subject.

3. Research Methods

A quasi-experimental approach was used to explain the topic of Direct and Inverse Proportion at Junior High School level to evaluate the effectiveness of micro-lectures. Based on Lo and Hew's research [53], the adoption of this approach can be divided into three experimental groups to evaluate student's learning performance and satisfaction. In this research, the mathematics teachers taught topics on Direct and Inverse Proportions at Junior High School level for six years and have four years of experience using micro-lectures to teach these topics.

3.1. Participants

The mathematics topic of direct and inverse comparison is generally taught in Grade 7 Junior High Schools in Indonesia. The research sample comprises 108 grade 7 students from three classes in a public Junior High School in West Java. Students were divided into three groups, the experimental classes I and II and the control, which consisted of 30, 29, and 30 students, respectively. Furthermore, the same teacher taught all students at different times. Those in the experimental class I used micro-lectures to prepare and review topics on direct and inverse proportion outside the classroom. In group II, the teacher used a projector or displayed the same approach in the classroom on an interactive whiteboard. The control class used traditional paper-based materials and a narrative, expository instructional approach to explain direct and inverse proportions.

3.2. Learning Materials

In this research, students are introduced to basic knowledge and concepts of direct and inverse comparison. This topic was selected because it is related to students' daily activities and the basis for studying other algebraic materials at a higher level. Most importantly, it was discovered that many students had difficulty in mastering Direct and Inverse comparison. The basic competencies according to the standard curriculum issued in 2018 are as follows:

- Students can explain the difference in comparing direct and inverse values by using tables, graphs, and equations.
- They can solve problems related to the comparison of grades and returns.

As previously explained in the introductory section, micro-lectures in this research have a video duration of 9 min 7 s which aims to encourage students to analyze and define the basic concepts of Direct and Inverse Comparison topic material. They were produced with a tablet, PPT, and some animations in Canva. Finally, micro-lectures were uploaded onto YouTube to make it easier for students to access. Video micro-lectures can be seen at the following link: https://www.youtube.com/watch?v=26YtfOs25f8&ab_channel= NivaRamadhaniPutri (accessed on 10 May 2022). It can be viewed on all modern internet-connected devices, such as smartphones, tablets, and computers with different OS. For some students with a limited quota to access YouTube videos, these micro-lectures are also shared on WhatsApp groups.

The material design is adapted for teaching and encourages students to analyze and understand the concepts of Direct and Inverse Proportion (Figure 1). In the video, this topic was discussed using story-type questions and a contextual learning approach, linking direct and inverse comparisons with familiar objects according to the directives of the national curriculum (Figure 2).
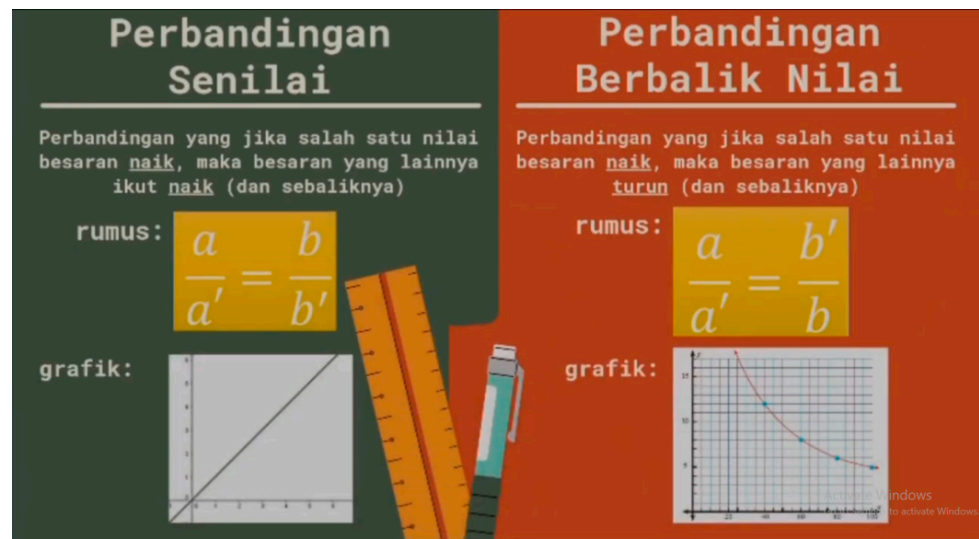
Figure 1. Part of micro-lectures that promote students to analyze and differentiate direct and inverse proportion topics independently.
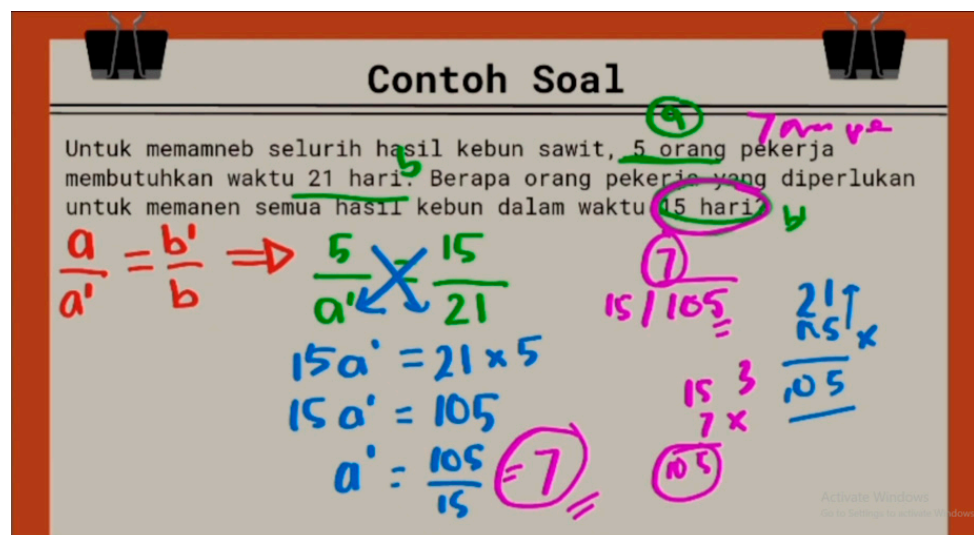

Figure 2. Explanation of type inverse topic exercises on micro-lectures.

The entire process involved in making these videos is monitored and checked by experts in the fields of educational technology, development, micro-lectures training, and mathematics education from Beijing Normal University China. Once they were approved, the initial draft of the Direct and Inverse Proportions PPT was made into micro-lectures. In the subsequent step, this technique was used to evaluate the curriculum in schools and experienced senior mathematics teachers. In accordance with their suggestions, minor corrections were made, such as making the discussion of questions easier, adding music and some animations, trimming some unnecessary parts, and focusing on understanding the basic concepts of direct and inverse proportions. Before the micro-lecture was used as an experimental material, it was given to two classes consisting of 61 students to analyze whether it was ready to be used.

Micro-lectures are designed to change the classroom atmosphere and the monotonous learning process from teacher to student-centered [26,42]. Besides, these animations tend to trigger students' interest in studying mathematics. High-level visualization of abstract mathematical concepts was made possible through the process of representing certain principles or problems. This technique aids students in recognizing and reviewing the

properties of objects, focusing on mathematical characteristics, and analyzing the relationship between the concepts. Therefore, a micro-lecture is perceived as a cognitive tool because it aids in imbibing mathematical ideas simultaneously. In this situation, it creates an environment for students to explore, thereby promoting independent learning and higher-order thinking. Typical interactive levels trigger them to learn through exploration while watching these videos. Micro-lectures stimulate students to ask questions and think creatively about a certain issue and whether there are other possible ways to solve it. This also stimulates their creative and critical thinking toward mathematical concepts. Micro-lectures ensure learning is centered on students and motivates them to be independent. It also helps them to visualize certain problems and manipulate algebraic constructions in a meaningful way. The use of micro-lectures to support interactive environments enables the transformation of procedural knowledge, such as remembering formulas and knowing how to use procedures to a conceptual one, including understanding concepts, operations, and the associated relationships. Such an atmosphere empowers students by enhancing their ability to explore micro-lectures, and thus reconstruct and explain mathematical concepts by bridging the gap between graphical representations and formal definitions.

3.3. Procedures

The experimental and procedural processes were carried out in three meetings, and each lasted for 2 h with a total learning duration of 90 min. Before starting this research, the teacher was directed and guided on how to use micro-lectures by both material and media experts. This section provides a detailed explanation of how microgames work, the teacher's position in the experimental class, and interactive sessions when using this approach. This research was carried out in the second semester of the 2021/2022 academic year. Students had not received any material on Direct and Inverse Proportion at the previous education level. The complete research procedure is shown in Figure 3.
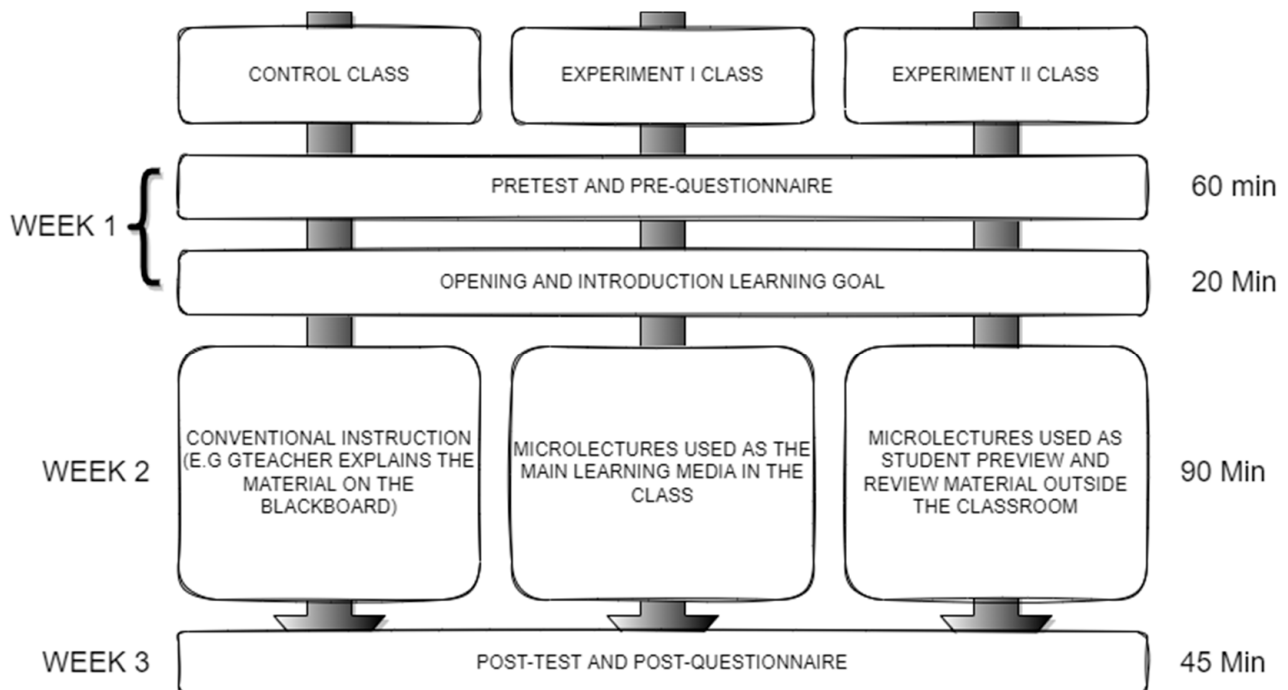

Figure 3. Research procedures.

Learning activities in the control class are not different from the traditional expository approach commonly used by teachers. At the first meeting, the learning objectives of the direct and inverse comparison material were conveyed, and a pretest was conducted. In the second week, the teacher in the experimental class I taught students with micro-lectures

using a projector during the opening section. This video was played two to three times during the lesson based on students' demands until they adapted to the part where they found it difficult to understand the knowledge points. In the final aspect, they were asked to work on some tasks contained in the video. Students were allowed to discuss with their classmates, and in this case, the teacher, as an assistant in the learning process (Figure 4), helped by explaining the points that should be considered. During learning, the teacher controls and encourages students to be active but not dominate. These activities are focused on students, their interaction and discussion, as well as micro-lectures themselves. In experimental class II, students were given micro-lectures a week before the main class commenced, enabling them to preview certain topics. The use of micro-lecture media, which allows students to learn from anywhere (see Figure 5) using computers, tablets, and smartphones, is more flexible. Those that do not own computers or tablets can borrow their parents' cellphones to watch the learning videos. Meanwhile, the learning activities were similar to those executed in the control class, where an expository approach was adopted. After classes, students returned to review and work on assignments, and at the final meeting, an assessment was conducted using post-test.

Figure 4. The teacher instructs students to watch the videos on the concept of direct and inverse proportion, and they actively ask and discuss some questions (**left**). There was a misunderstanding, and the teacher helped to resolve the issue (**right**). The learning activities remained student-centered.
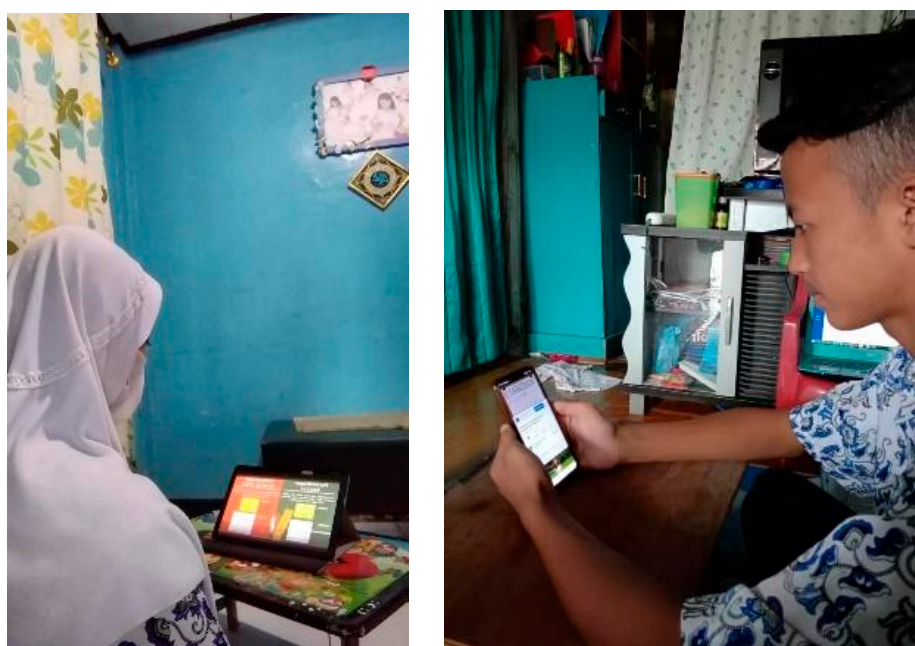

Figure 5. Students use micro-lectures to preview direct and inverse proportion topics at home.

3.4. Research Instruments

The pre- and post-test questions were obtained and modified from the second-semester mathematics book issued by the Ministry of Education and Culture and are in accordance with the 2018 curriculum (see Appendix A). In addition, it is the same as the test assessment. The pre-test is designed in accordance with the basic competencies and standards of the direct and inversely proportional materials. It consisted of 20 multiple choice questions, each awarded five points, resulting in a total score of 100. A total of 29 students were assessed, and the scores were analyzed using the SPSS statistical tool to verify the discriminant and difficult test items. The discrimination rate and difficulty level were discovered to be 44% and 48%, respectively. The validator group consists of two material experts responsible for validating the test items, while the overall Cronbach alpha value for the instrument was 0.71. This simply means that it is in the category of acceptable internal consistency [54] and can be used to measure students' achievement on the topic of Direct and Inverse Proportion. The detailed questions are shown in Appendix A.

Six items were adopted from Li's research [43] regarding learning satisfaction. Cronbach's alpha value obtained is 0.91, and all items contained in the questionnaire were checked and appropriately modified to fit the context of this study by two survey experts. Each questionnaire uses a 5-point Likert scale from the range of one—strongly disagree to five—strongly agree. Furthermore, all items were translated by linguists from English to Indonesian to match the students' mother tongue.

3.5. Data Analysis

Statistical descriptive measures, t-test analysis, and ANCOVA were applied to achieve the research objectives associated with determining the effect of micro-lectures on student learning outcomes relating to the topic of Direct and Inverse Proportion at the Junior High School level. All evaluations were performed using the Statistical Package for the Social Sciences version 22 (SPSS 22). A significance level of 0.05 was adopted for the statistical analysis.

4. Results

This section presents the pre-test and post-test data and shows the findings in two parts based on the results of data processing. According to the research objectives, these findings are: (1) the effect of micro-lectures on learning performance, and (2) students' satisfaction.

4.1. Learning Performance

Twenty multiple-choice questions were used to assess students' achievement before they undertook the activity. Table 1 shows the ANCOVA results from the three-class pretests. It is evident that there was an insignificant difference (F score 0.09; $p > 0.05$), and this indicates that the three classes had similar learning achievements before participating in this experimental research.

Table 1. ANCOVA results of the pre-test student achievement from 3 classes.

Class	N	Mean	Std. Deviation	Std. Error	F Score	*p* Value
Control	32	55.93	17.01	3.00		
Exp 1	30	56.13	20.15	3.67		
Exp 2	33	57.75	20.02	3.48	0.09	$p > 0.05$
Total	95	56.63	18.91	1.94		

After the three classes were treated differently, ANCOVA was used to compare the post-test results and students' achievements, as shown in Table 2 The experimental I, II, and control class averages are 74.18, 85.00, and 86.66, respectively. Furthermore, it was discovered that the three classes had significant differences in student achievement, with an F score of 7.034 and a *p*-value of less than 0.05. The post-activity games test results in

Table 2 show that the experimental classes I and II are better than the control group. This shows that using micro-lectures inside and outside the classroom significantly improves student achievement compared to the traditional expository learning model. Table 3 shows an insignificant difference between the experimental classes I and II ($p > 0.05$).

Table 2. ANCOVA results of post-test student achievement from 3 classes.

	N	Mean	Std. Deviation	Std. Error	F Score	*p* Value
Control	32	74.18	23.385	4.133	7.03	$p < 0.05$
Experiment I	30	85.00	6.695	1.222		
Experiment II	33	86.66	5.543	0.964		

Table 3. The difference between the control class, experiment I, and experiment II using Games–Howell–based post hoc for multiple comparisons.

	Class	Class	Std. Error	Sig.
Games–Howell	Control	Experiment I	4.31	0.043
		Experiment II	4.25	0.016
	Experiment I	control	4.31	0.043
		Experiment II	1.56	0.536
	Experiment II	control	4.25	0.016
		Experiment I	1.56	0.536

Figure 6 shows the effect of employing micro-lectures with different learning approaches in the experimental and control classes on students' achievement. The pre-test results of the three classes have an insignificant difference. The pre-test result indicated a situation that is suitable for giving different treatments to each class and analyzing the results of the post-test afterward. It is necessary to find a class with a balanced initial ability to conduct pre-test and post-test experimental research. Meanwhile, the post-test results of the experimental classes 1 and II based on using micro-lectures in and outside the classroom seemed to have an insignificant difference in the learning achievement compared to the control group. The use of micro-lectures outside the classroom, before and after learning, had a slightly higher pretest result (1.17 points) compared to using a projector in the classroom. This implies that students' performances can be affected by managed learning activities which play an important role when used at home. Independent learning tends to have a positive impact on their achievements. The diverse test results obtained using SPSS and post hoc Games–Howell in Table 3 show an insignificant difference between experimental classes I and II.

4.2. Learning Satisfaction

To provide answers to the second question regarding the differences in using micro-lectures on students' satisfaction, this research analyzes the three classes based on their responses to the post-questionnaire. Levene statistics were used to determine the homogeneity of the data, and the test results show $p < 0.001$, indicating that the variance between the groups had significant differences. Furthermore, the one-way ANCOVA was conducted to discern the difference between the three classes.

The ANCOVA findings in Table 4 show significant differences between the three classes (F = 21.26 and *p*-value < 0.001). Furthermore, the post hoc Games–Howell analysis results in Table 5 lead one to believe that the experimental classes I and II had significant differences when compared to the control group. The learning satisfaction of the experimental classes I and II showed an insignificant difference. The average learning satisfaction in experimental class II is slightly higher (0.22) compared to that discovered in I. This shows that the learning satisfaction of students who use micro-lectures outside of school to review and do homework is higher than in the classroom, although this difference is statistically insignificant. This is because the structure of micro-lectures differs from the

way teachers explain in class. In general, micro-lectures only explain one to two important points without complex systems and explanations [55], combined with fun, interesting videos and illustrations for Junior High School students; hence, they are satisfied with the learning media.
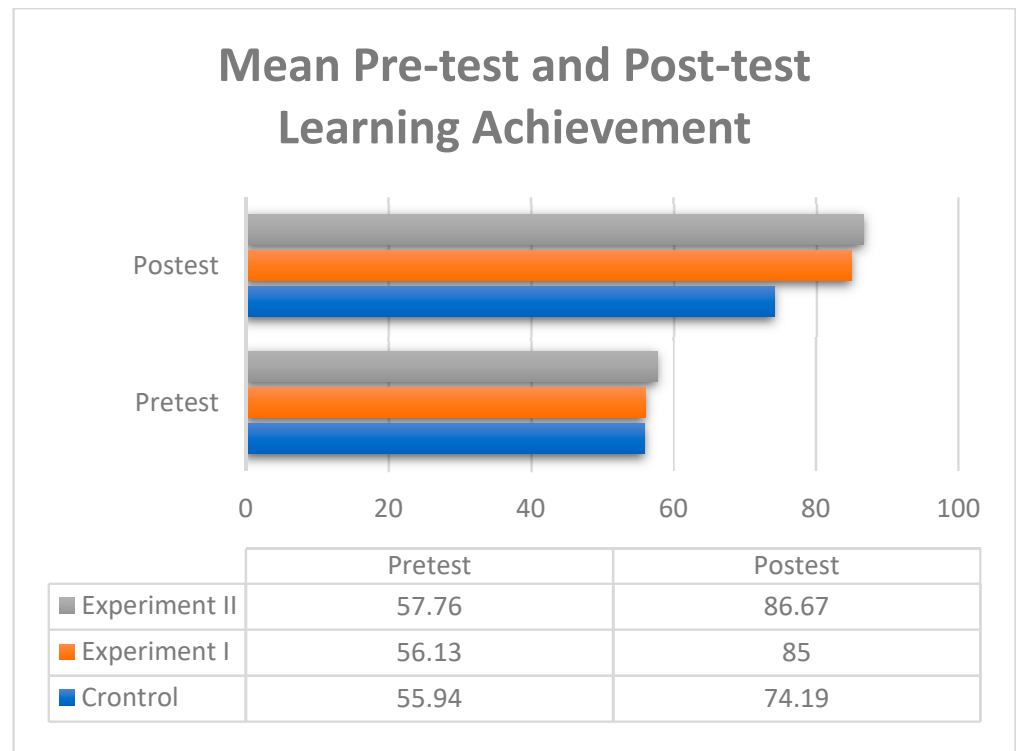

Figure 6. Mean pre-test and post-test student achievement score line graph.

Table 4. ANCOVA learning satisfaction for the three classes.

	Class	N	Mean	SD	F	*p* Value
Learning satisfaction	Control	32	3.28	0.77	21.26	*p* < 0.001
	Experiment I	30	4.23	0.81		
	Experiment II	33	4.45	0.71		

Table 5. Different tests of mathematics learning satisfaction between control class, experiment I, and experiment II using Games-Howel-Based post hoc for multiple comparison.

	Class	Class	Std. Error	*p* Value
Games–Howell	Control	Experiment I	0.202	*p* < 0.001
		Experiment II	0.189	*p* < 0.001
	Experiment I	Control	0.202	*p* < 0.001
		Experiment II	0.198	*p* > 0.05
	Experiment II	Control	0.189	*p* < 0.001
		Experiment I	0.198	*p* > 0.05

Micro-lectures provide opportunities for mathematics teaching and learning activities. The fun atmosphere enabled by the teachers has more innovative value, because the content provided is more abundant and in accordance with the approach or model used in schools. For example, teachers can combine micro-lectures with a flipped classroom approach, online, blended, and other learning approaches.

5. Discussion and Implications

This research aims to examine the effect of micro-lectures on students' learning achievement and satisfaction. The results showed that the experimental class had a higher average score than the control. Students who previewed the topic of Direct and Inverse Proportions at home were more active in participating in learning activities in class, where interactions with the teacher are smoother. This is because reviewing it at home lets students have an overview of the material to be studied in class. Some have the courage to ask and work on the questions given by teachers in front of the class. The way they learn using micro-lectures is more interesting than previewing lessons using a mathematics textbook; therefore, learning mathematics through this technique makes students enthusiastic about waiting for the next math topic. This research is in line with Wijaya et al. [55], who adopted this approach and found that it has a substantial impact on students' learning performance and provides opportunities for them to study independently and solve problems in class, compared to traditional expository learning. It also increases students' opportunities to interact with peers.

Furthermore, these findings are statistically insignificant in terms of either using micro-lectures in the classroom or providing learning support for students outside the school as material for reviewing and previewing lessons. This shows that both ways equally stimulate their achievements compared to the control group and tend to increase its effect. The results were obtained following the research by previous researchers [54,56]. Furthermore, it shows that using micro-lectures has higher learning satisfaction than the conventional expository learning approach. This is in line with the research by Han [57], who found that this method increases motivation and makes learning more interesting. Micro-lectures invite students to actively participate during class lessons, including mastering basic math concepts. However, there are also challenges associated with the use of micro-lectures outside the classroom. For instance, some students at home do not have a personal smartphone or tablet to study; hence, they have to use their parent's tablet or smartphone. Furthermore, parents also need to pay attention to whether students are really learning by providing full parental support.

The use of micro-lectures in the classroom or as preview and review materials for students has its advantages. They feel it is interesting and offers new experiences compared to the traditional expository approach, where they are only required to listen to the material explained by the teacher and study the formulas on the blackboard. The background and animation of micro-lectures causes them to enjoy studying the Direct and Inverse Proportion material. The discussion of practice questions using this approach is related to objects encountered daily by students, thereby making it easier for them to understand the basic concepts of direct and inverse comparison material. Hu et al. [58] also explained that the benefit of micro-lectures made by teachers is higher than that made by expert developers, and it can be modified to suit the conditions of the class, which promotes students to participate actively and discuss how to solve the problems together as well as capture basic concepts of the material being studied. Its adoption is believed to be more practical and has a significant positive effect on mathematics lessons. Furthermore, the advantage of using this method outside of class is that reviewing mathematics lessons gives students more freedom to set study time and repeat the video several times for in-depth understanding. Their learning satisfaction is higher, supported by several studies that used micro-lectures as flip classroom material and reported undoubted results. When students review the material and obtain basic knowledge before class, they are more likely to quickly and easily understand the subject being taught. Furthermore, the use of tablets or smartphones outside the classroom as a medium for watching micro-lectures educates students on the use of these devices for other purposes besides media entertainment. Learning media is flexible and can support all student learning styles by enabling them to have full control of its use when studying, preparing for class, reviewing, or doing homework.

6. Limitations

Certain limitations of our study suggest areas for further research. First, this research only covered direct and inverse comparison, whereas other mathematics materials may have different results. Therefore, there is a need to analyze the effect of micro-lectures on other topics and at different levels of education. Second, it did not analyze students' behavioral patterns in the learning process, which might help to obtain more in-depth information about the effectiveness of this method. Third, it only includes a short intervention, namely three weeks, which may affect the use of micro-lectures because of the novelty of the learning media. It is recommended that longitudinal research should be carried out with a larger scale sample to discern the effect of this approach and explore other strategies to improve students' learning outcomes.

7. Conclusions

Several research studies have analyzed the effectiveness of micro-lectures which have tended to focus on testing learning achievement and affective factors such as student attitudes and motivation. Although many investigations reported that this method has positive effects, this research focuses on analyzing variations in its usage. The results provide a major contribution, showing that the class that was taught with micro-lectures performed better than one taught with the conventional expository approach. Based on the fact that there is an insignificant difference between the use of this method in the classroom and its provision as a preview and review material for mathematics lessons, teachers need to employ a learning approach that suits their circumstances or alternately use the two approaches to obtain the maximum effect from micro-lectures. This research suggests that the use of micro-lectures as supported learning media in mathematics lessons plays an important role in learning achievement and students' satisfaction.

Appendix A. The Questions test about the Topic of Direct and Inverse Proportion

Subjects	: Mathematics
Class	: VII ____
Student's name	: _____

1. The ratio of the chocolate and candy below is . . .

   A. 6:9
   B. 9:6
   C. 3:5
   D. 5:3

2. Students in classes VII and VIII collect data on various types of food they like.

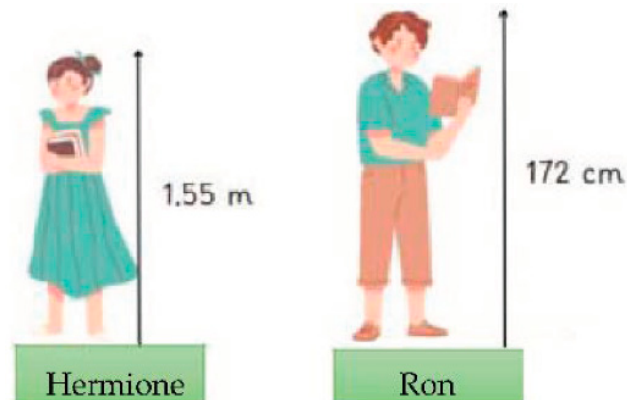| Food Type	Class VII Students	Class VII Students
Fried rice	65	80
Gado-Gado	100	150
Meatball	125	200

The ratio of class VII students who like fried rice to those who like *Gado-Gado* in class VIII is . . .
   A. 1:2
   B. 2:5
   C. 4:5
   D. 13:30

3. The equivalent ratio of 30 min:450 s is . . .
   A. 2 months:12 days
   B. 1 year:256 days
   C. 28 days:1 week
   D. 2 weeks:2 days

4. Look at the picture below!

The ratio of Hermione's and Ron's heights (in cm) is . . .
A. 155:172
B. 172:155
C. 1.55:172
D. 172:1.55

5. The ratio of Harry and Ron's ages is 4:5. If Harry's age is 20 years, then Ron's age is . . . years

A. 24
B. 25
C. 26
D. 27

6. The ratio between Andi and Boni's weight is 7:8. If Boni's weight is 48 kg. Andi's Weight is . . . kg

A. 42
B. 43
C. 44
D. 45

7. If the ratio of Ratu and Irena's money is 3:5 and the amount of their money is Rp. 560,000.00, which of the following statements is "FALSE" . . .

A. Ratu's money is less than Irena's money
B. Ratu's money is Rp. 350,000.00
C. Irena's money is Rp. 350,000.00
D. The difference in their money is Rp. 140,000.00

8. Budi's mother has just given birth to a baby with a height of 48 cm. If Budi is 72 cm taller than his sister, then the ratio of Budi's height to his sister is . . .
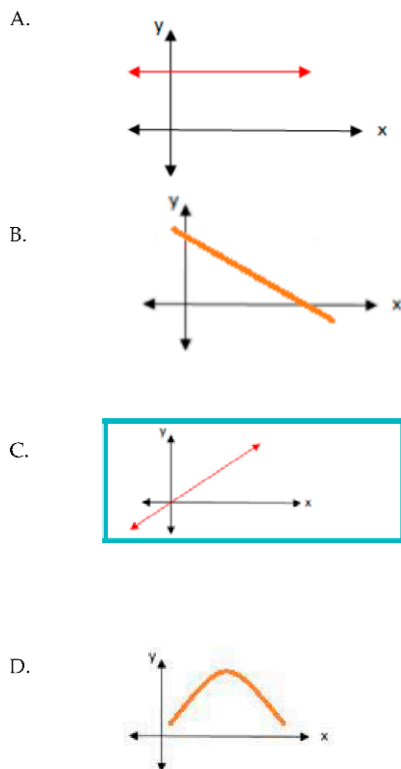
A. 5:2
B. 2:5
C. 3:2
D. 2:3

9. The distance from Cimahi to Jakarta on the map is 6 cm. The map scale used is 1:2,000,000. The actual distance from Cimahi to Jakarta is . . .

A. 120 km
B. 1.200 km
C. 300 km
D. 3.0000 km

---

10. The actual length of an island is 17.5 km, if drawn on a map with a length of 10 cm, then the scale used is . . .

A. 1:1750,000
B. 1:175,000
C. 1:17,500
D. 1:1750

---

11. Which of the following is a graph worth?

A.

B.

C.

D.

---

12. The distance from Wahyu's house from campus is 10 km, but he only has 0.5 L of gasoline in his motorbike. If the mileage of Wahyu's motorbike is 50 km per 2 L, will the gasoline be sufficient to get him home?

We can conclude that the above problem is a . . .

A. Comparison Worth
B. Inverse Comparison of Values
C. Scale Comparison
D. Temperature Comparison

13. The distance from Wahyu's house from campus is 10 km, but he only has 0.5 L of gasoline in his motorbike. If the mileage of Wahyu's motorbike is 50 km per 2 L, will the gasoline be sufficient to get him home? If so, how much fuel is left?

A. Yes enough, nothing left
B. Yes, that's enough, Wahyu's remaining gasoline is 0.4 L
C. That's enough, Wahyu's remaining gasoline is 0.1 L
D. Not enough

14. If a 30 m² pond can accommodate 10,000 catfish, what size pond can accommodate 20,000 catfish?

A. 80 m²
B. 60 m²
C. 40 m²
D. 20 m²

15. A car uses 7 L of gasoline to cover a distance of 49 km. If the distance traveled is 21 km, the gasoline needed is . . . L

A. 1
B. 2
C. 3
D. 4

16. Examples of **values inverse comparisons** that you encounter in daily life are in the statement

A. The distance traveled and the amount of gasoline used by the vehicle
B. The number of items purchased and the amount of money to pay for these items
C. The number of workers and the time needed to execute a job
D. Distance and travel time of a vehicle

17. A contractor estimates he can complete a job in 48 days with 14 workers. If the job is to be completed in 21 days, the number of workers needed is . . .

A. 32
B. 33
C. 34
D. 35

18. In the "FARMING MANIA" farm, 15 cows can clear grass in a field in 10 days. If the owner sells 5 cows, how long will it take for the remaining cows to clear the grass?

A. 15 days
B. 20 days
C. 25 days
D. 30 days

19. Pay attention to the following table!

Speed (km/h)	Traveling Time (h)
10	20
20	t
v	5

The t and v value in a row is ...

A. $=10$ and $=40$
B. $=15$ and $=35$
C. $=20$ and $=30$
D. $=25$ and $=20$

20. Read the following statement carefully

The feed available at Pak Ramdan's chicken farm is sufficient to feed 150 chickens for 6 days. If 30 chickens are added, **the feed will run out in 10 days**. Is the statement in bold true?

A. It's true
B. Wrong, it should be "the feed will run out in 5 days"
C. Wrong, it should be "the feed will run out in 4 days"
D. Wrong, it should be "the feed will run out in 3 days"

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