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The Effect of Differentiated Learning assisted by Liveworksheet on Student Learning Achievement in Mathematics Subjects in Senior High School

Dini Dahlia[1*], Hepsi Nindiasari[2]
[1,2]Mathematics Education Study Program, Universitas Sultan Ageng Tirtayasa

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***Correspondence Address:**
dinidahlia84@guru.sma.belajar.id

Abstract: In the learning process, teachers are confronted with a diversity of potentials among learners. Therefore, teachers must possess the ability to develop learners according to their existing potentials so that their learning achievements can improve. A strategy used by educators to address every student's learning requirement is differentiated education with the help of liveworksheet. This study aims to determine if customised instruction with real-time worksheet support affects students' learning outcomes. A one-group pretest-posttest quantitative quasi-experimental design is the study methodology used. The subjects consisted of 35 students from class XII IPA-5 at SMA Negeri 1 Jawilan, Kabupaten Serang. A test was used to obtain data. The pre-test scores resulted in an average of 28,29, while the post-test scores yielded an average of 58,86. As a result, the average score increased by 30,571 between the pre- and post-tests. The paired sample t-test indicates that the rejection of H0 and acceptance of H1 is indicated by the sig value (2-tailed) of 0,000 < 0,05, based on data analysis using SPSS version 23. The results of the study demonstrate that tailored teaching based on live worksheets has an effect on the mathematical learning outcomes of students at SMA Negeri 1 Jawilan, Kabupaten Serang.

INTRODUCTION

Maths is a field of science that has many connections to everyday life. Maths, on the other hand, is still considered difficult by students. This can be seen from the low level of learning achievement in mathematics compared to other subjects. Learning achievement is the result achieved by students after undergoing the learning process (R. Rantau, Syamsuri, 2022). Learning achievement in mathematics is the result of various efforts. Sutikno (Al Mawaddah et al., 2021) says that there are two types of factors that affect student learning outcomes: internal factors. Internal elements are those that originate from within the student, including intelligence, focus and interest, perseverance, learning motivation, attitude, learning habits, and physical and health state. Internal elements are those that originate from within the student, including intelligence, focus and interest, perseverance, learning motivation, attitude, learning habits, and physical and health state. External factors, which include things that come from outside, such as media and learning quality. Other external factors that originate from outside the individual and have an impact on student learning achievement include family

circumstances, the school environment, and community situations. Other internal factors that affect student learning achievement include self-efficacy, emotional intelligence, learning motivation, and interest in learning (Aswin, 2019).

According to the philosophy of progressivism education, everyone is born with different talents and abilities, especially the power of reason, so that they can overcome all problems in their lives (Salu, 2017). Based on this understanding, all human beings when born are not a ‘blank paper’ that needs adults to fill it in. In a similar vein, students' talents are not, by definition, a "blank sheet" that the teacher can fill with anything. However, learners already have ‘faint lines’ or potential that they carry from birth. The teacher's job is to thicken these faint lines so that students can reach their maximum potential and improve their behaviour to become a complete human being who is beneficial to others and their environment.

Teachers are faced with the diversity of student potential. Therefore, teachers must have the ability to develop students according to their potential. If teachers continue to use the old approach of homogenising students' abilities, their potential will not be fully developed. Teachers must make various efforts to fulfil students' learning needs so that students can be optimal in their learning process.

Differentiated learning, also known as differentiated teaching or differentiated instruction, was first proposed by Carol Ann Tomlinson as a means for teachers to meet all of their students' learning needs. Differentiated learning, according to Corley (Siburian et al., 2019), is a technique that enables teachers to develop tactics to match the needs of each student. Differentiated learning is based on the diversity of readiness, learning profile, and interest, according to Champan and King (Siburian et al., 2019). However, differentiated learning does not mean that teachers have to teach 30 students in different ways and then have to help all students and run here and there simultaneously to fulfil their learning needs, nor does it mean that teachers group students homogeneously based on their abilities and then increase the number of questions for students with higher abilities.

Differentiated learning is a collection of logical decisions made by teachers based on students‘ needs and clearly defined learning objectives; learners’ learning needs, whether to differentiate learning content, learning processes or learning products; scaffolding or learning methods where teachers adjust support to learners based on their cognitive abilities; effective classroom atmosphere; diagnostic tests conducted by teachers to identify students' learning needs.

To implement effective differentiated learning, in addition to teachers‘ understanding of students’ learning needs, learning media and instruments are also needed to suit students' needs. With today's highly developed technology, teachers can utilise it to help students learn. According to Sardiman (Baharuddin & Wahyuni, 2008) one of the external supporting factors that motivate students to learn that can be provided by teachers is by processing teaching materials. Electronic learner worksheets (E-LKPD) are learning tools that teachers can use. According to Sari (Bombang et al., 2022), Electronic student worksheets are instructional materials that are arranged in a methodical manner according to certain learning units and include interactive features such as navigation, videos, animations, and photos. Electronic student worksheet can be created with the help of various applications, one of which is liveworksheet. Liveworksheet is an electronic worksheet with various latest features that can be created by teachers tailored to

student learning needs. Learning needs in this study refer to students' learning styles. Learning styles refer to individual preferences in how to think, process and understand information where there are three main types of learning styles, namely visual, auditory and kinesthetic (Prihasyto et al., 2019):

1. Visual Learning Style: A learning style that relies on vision to receive and process information. Its characteristics include:
   a. Organised and neat
   b. Speaks quickly
   c. Not easily distracted by noise
   d. Remember what is seen better than what is heard
   e. Prefer to read rather than listen to readings
   f. Fast and diligent reader
   g. Know what they want to say, but not good at choosing words
   h. Remembers visual associations
   i. Has difficulty remembering verbal instructions unless written down, and often asks for repetition
   j. Attentive to detail
2. Auditory Learning Style: A learning style that relies on hearing to facilitate the learning process. Characteristics include:
   a. Talking to oneself while working
   b. Easily distracted by noise
   c. Likes to read aloud and listen
   d. Difficulty writing but good at telling stories
   e. Learn by listening and remember discussions better than visuals
   f. Likes to talk, discuss, and explain at length
3. Kinesthetic Learning Style: A learning style that more effectively absorbs information through movement, action, and touch. Characteristics include:
   a. Speaks slowly
   b. Difficult to remember maps unless they have been in the place
   c. Memorise by walking and looking
   d. Uses finger as a pointer when reading
   e. Cannot sit still for a long time
   f. Writing may not be neat
   g. Always physically active and moves around a lot
   h. Wants to do a variety of activities

By understanding these learning styles, students and educators can customise learning methods to improve learning effectiveness. For example, visual students will do better with visual materials such as graphs and videos, auditory students with oral delivery or discussions, and kinesthetic students with practical activities or simulations.

Liveworksheet can be combined with various media such as video, audio, animation, images, etc. as a product, so students can access it anytime and anywhere with their electronic devices. By using liveworksheet, teachers can create various student worksheet according to students' learning needs.

The driving school programme is one of the government's programmes in the field of education that aims to realise the Indonesian Education Vision, which is to make Indonesia advanced, independent, and have a personality. SMAN 1 Jawilan, Serang Regency is one of the schools in the province of Banten that has adopted the driving school programme. Teachers must take action to maximise the quality of their pupils, particularly during the learning process. One such action is the use of differentiated instruction.

According to previous research by Widyawati (2023) on differentiated learning on social studies materials in primary schools, it was implemented successfully. Furthermore, research conducted by Siburian et al. (2019) found that differentiated learning in mathematics subjects in class VIII junior high school can improve students' ability to solve mathematical problems. Furthermore, liveworksheet-based scientific student worksheet helps understand mathematical concepts about social arithmetic in a valid, practical, and effective way (Amalia & Lestyanto, 2021). Interactive student worksheet products based on liveworksheet are also valid, practical, and effective (NF et al., 2022).

Starting from the diversity and problems of the learning process that have been described, the researcher wants to find out whether there are differences in student learning outcomes in mathematics subjects in Senior High School. The researcher has determined the focus of the research on class XII Mathematics learning in the odd semester.

METHOD

This study used a pretest-posttest approach with a single group to conduct a quasi-experiment. Students' pretest results before and after therapy are compared as a means of measuring this design, according to (Arikunto, 2006). Adjusted to the research design, the scope of this study included differentiated learning. Only one experimental group in this study conducted a pre-test (T_1) to determine the initial conditions, treatment (X) then post-test (T_2) to determine the final results. As a result, the researcher can compare the conditions before and after the treatment. Table 1 shows the research design:

Table 1. One Group Pretest-Posttest Research Design

Pretest	Treatment	Posttest
T_1	X	T_2

Description:

T_1 = Pretest score (before learning)

X =Treatment with differentiated learning aided by liveworksheet

T_2 = Posttest value (after learning)

Furthermore, the test results are evaluated and interpreted to determine the impact of the treatment (X). If there is a significant difference between the pre-test and post-test, it can be concluded that there is an effect of assisted differentiated learning in improving the learning achievement of students of SMA Negeri 1 Jawilan.

The cluster random sampling method divides the population as a whole into several parts or clusters, each of which represents the population. This method was used to select research

subjects. A total of 35 students of class XII IPA-5 at SMA Negeri 1 Jawilan, Serang Regency, took this sample. Tests were used to collect data. The data instrument consisted of descriptive questions covering cognitive aspects. In this research process, at the beginning, students were grouped based on their learning style based on the results of the learning style test that had been conducted. Additionally, by utilising liveworksheet's features, student worksheets (LKPD) were created in three different formats based on the learning styles of the students: auditory, visual, and kinesthetic. Next, depending on their preferred method of learning, students select their own LKPD.

Data analysis used two prerequisite tests: normality test and homogeneity test. The normality test uses the Kolmogorov Smirnov formula, while the variance homogeneity test can be done using the SPSS version 23 programme. After the prerequisite test is complete, the calculation of the t-test, namely the paired sample t-test.

RESULTS AND DISCUSSION

The results of the Research on the Effect of Differentiated Learning Assisted by liveworksheet on Student Learning Achievement in Mathematics Subjects at SMA Negeri 1 Jawilan, Serang Regency are presented below. This study was conducted on 35 students in class XII IPA-5.

Table 2. Pre-test and Post-test of student learning outcomes

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	28,29	35	14,849	2,510
	Posttest	58,86	35	18,274	3,089

Student learning outcomes before the application of differentiated learning with liveworksheet, which got an average score of 28.29. Furthermore, researchers conducted a post-test question, which got an average score of 58.86, to find out whether learning had an effect. The results showed an increase in the average score of 30.571 between the pre-test and post-test. Table 3 below shows the results of prerequisite testing for normality and homogeneity.

Table 3. Normality test results of student learning outcomes data

	Kolmogorov-Smirnov		
	Statistic	df	Sig.
Posttest	0,143	35	0,067
Pretest	0,146	35	0,057

The results of the normality test calculation show that the data fulfil the assumption of normality ($\alpha > 0.05$), with a pretest value of 0.067 greater than 0.05 and a posttest value of 0.057 greater than 0.05. This indicates that the data distribution in the data groups or research variables is normal (Kadir, 2022).

Table 4. Homogeneity test results of student learning outcomes data

Levene Statistic	df1	df2	Sig.
1,201	1	68	0,277

Using the levene statistical method, as shown in Table 4, it was found that the sig. value of 0.277 is more than 0.05, which means that the research data is homogeneous.

After the data analysis prerequisite tests, namely normality test and homogeneity test, were calculated, and the results showed that the data were normal and homogeneous. Furthermore, researchers can conduct hypothesis testing, namely the t-test, which is found in Table 5 with the help of SPSS version 23.

Table 5. paired sample t-test calculation results

Paired Differences									
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Pretest - Posttest	-30,571	9,375	1,585	-33,792	-27,351	-19,291	34	0,000

Using SPSS version 23, the paired sample t-test calculation results indicated that if the two-tailed sig value was less than the α value (0.05), then H0 was rejected and H1 was accepted. The computation in Table 5 indicates that the significance value is less than 0.05. Thus, it can be said that the use of liveworksheets influences the mathematical learning success of students at SMA Negeri 1 Jawilan, Serang Regency.

Based on the explanation above, it can be concluded that differentiated learning assisted by liveworksheet affects students' learning achievement. Differentiated learning is a learning approach that accommodates student learning needs, one of which is based on student learning styles, then liveworksheet is one of the learning tools that can be used to create student worksheets in digital form. These worksheets now have complete and attractive features to help different learning processes. This creates a learning atmosphere that is not boring and the material can be delivered well, which results in improved student learning achievement.

It is crucial for teachers to improve their students' learning outcomes by using various approaches and providing interactive, innovative and engaging learning media for students. Not only the use of learning media that can be used by teachers, but teachers should also encourage students to participate in activities to achieve their goals. Students are motivated to improve their learning outcomes through differentiated learning with the help of liveworksheet.

The above opinion shows that differentiated learning with the help of live worksheets can be one of the alternative approaches and learning media that are innovative, creative, and fun. In terms of mathematics, differentiated learning with the help of live worksheets can help and increase students‘ motivation to learn, which in turn will result in students who are more focused and enthusiastic in learning so that students’ learning achievement will increase.

CONCLUSION

This study concludes that there is a significant effect of 0.000 <0.05, which implies H0 is rejected and H1 is approved based on the data analysis that was done. This conclusion demonstrates how student learning achievement has increased at SMA Negeri 1 Jawilan, Serang Regency, following the implementation of differentiated learning with the aid of liveworksheets in the mathematics curriculum.

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