Union: Jurnal Ilmiah Pendidikan Matematika
Volume 11(2), 2023, pp. 294-304
https://jurnal.ustjogja.ac.id/index.php/union

Implementation of discovery learning model to improve student learning outcomes

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Received: ***23 May 2023****; Revised:* ***19 June 2023****; Accepted:* ***20 June 2023***

Abstract**:** *This study aims to determine whether the discovery learning approach for teaching mathematics has an effect on students' learning outcomes. This study is quantitative descriptive research with a pre-experiment, one-group pretest-posttest research design. The research subjects consisted of 31 students from class IXA at junior high school 36 Semarang. The students took a pretest before the implementation of the discovery learning model, and then a posttest was given after the implementation to measure the enhancement of students' learning outcomes. Pretest and Posttest findings revealed an increase in the average scores, which were 47.41 and 80.90, respectively, and the N-Gain test results showed a score of 0.61 in the moderate category. The study's findings shed light on the usefulness of the discovery learning approach in increasing the learning outcomes of class IXA students at junior high school 36 Semarang, particularly in the field of geometry transformation. From the results of the pretest, it was found that 31 students were in the low category. After learning with the discovery learning model, a posttest was carried out with the results of 7 students who were in the low category, 17 students in the medium category, and 7 students in the high category. There were significant changes in the participants' pretest and posttest scores, validating the efficacy of discovery learning strategies. Students who received instruction using the discovery learning model, in particular, had considerably higher posttest results as compared to their pretest scores. This demonstrates a significant increase in their comprehension and application of geometry transformation ideas following participation in the discovery learning technique. Through the discovery learning approach, teachers play a critical role in promoting student-centered learning. While the discovery learning model has been shown to be helpful in improving student learning outcomes, it is critical to investigate other instructional strategies and the use of educational technologies in future research and teaching practices. Additional study should be conducted to explore the usefulness of instructional technology and to establish best practices for its integration in order to improve student accomplishment in the digital era.*

Keywords: Discovery learning; Student learning outcomes; Geometry transformation

How to cite: Widolaksono, D. A. S., Harun, L., Ariyanto, L., & Supriyanto, A. (2023). Implementation of discovery learning model to improve student learning outcomes. *Union: Jurnal Ilmiah Pendidikan Matematika*, *11*(2), 294-304. https://doi.org/10.30738/union.v11i2.14864

INTRODUCTION

Education is a learning process that is structured and organized with the intention of assisting students in acquiring the information, skills, and values needed to become members of society who are independent, productive, and able to contribute to their surroundings. There are various settings and methods for acquiring knowledge, taking into account formal, informal,

DOI: 10.30738/union.v11i2.14864

and non-formal education. The aim of education is to increase students' knowledge and skills, build good character, teach them how to think critically and creatively, and help them realize their full potential. According to Rahmat (2016), human development must be regulated through education so that it is more organized and based on mature thinking. due to its beneficial effects on both the growth and welfare of a country as a whole and the quality of life of individuals, it can be concluded that education is widely recognized as a vital tool for advancing society and the country as a whole.

Mathematics is known as the study of concepts, structures, and relationships between numbers, shapes, space, and change. Mathematics is a basic science that forms the basis for various fields of science and technology. Since many aspects of modern life depend heavily on technology and mathematical systems such as finance, transportation, and management, mathematics plays an important role in everyday life. According to Martini (2014), mathematics is related to understanding patterns and changes that occur in the real world and the relationships between these patterns as a whole in the human mind, so mathematics is a very important discipline to study. According to Rahayu (2013), mathematics can help in developing reasoning skills and logical thinking, so it plays an important role for students. This ability can be used to overcome the challenges faced in everyday life. In addition to solving everyday life problems, mathematics also teaches students how to understand complex ideas that are very useful in various areas of life and careers. Because it is always related to numbers, some students think that learning mathematics is difficult. Problems related to mathematics learning outcomes often arise in the school environment. Students' ability to understand mathematics and their academic achievement at a higher level can be affected by the unsatisfactory quality of mathematics learning outcomes.

Based on the pre-test results of the geometry transformation material carried out in class IXA at junior high school 36 Semarang, no students were able to achieve the mastery learning standard. This shows that the student learning outcomes of class IXA at junior high school 36 Semarang are still low. Student learning outcomes are an important indicator in evaluating the effectiveness of the learning process. However, often, student learning outcomes do not reach the expected standard.

Numerous internal and external factors impact students' learning results. Internal characteristics such as students' starting ability, curiosity, motivation, and learning styles, according to Sanjaya (2010), have a critical influence. External elements, on the other hand, include teacher competency, the learning environment, learning media, and instructional approaches. Low student learning results, according to Nuriyah et al. (2018), may be related to variables such as the learning environment, students' beginning skills, learning motivation, and the educational model used. As a result, selecting an effective learning model becomes critical in enhancing student accomplishment.

Yuniarti (2020), believes that active and interactive learning strategies in mathematics can improve students' learning effectiveness. Students are actively engaged in the learning process when approaches such as discussions, practicums, and group assignments are used, allowing them to comprehend mathematical concepts more successfully. Furthermore, these interactive techniques provide practical applications that connect arithmetic skills to real-life problems, resulting in enhanced problem-solving abilities and higher self-esteem (Rusli, 2020; Zakaria et al., 2010)

When these perspectives are considered together, it is evident that a comprehensive plan is necessary to improve student learning outcomes. It requires considering both internal and external challenges, adopting suitable teaching methods, and implementing active and participatory tactics that engage students meaningfully. By addressing these areas, educators may create an environment conducive to effective learning and increase students' overall academic achievements.

The discovery learning model was chosen because it encourages student participation. The discovery learning model will engage students' in actively seeking or discovering their own

solutions to a problem or scenario presented by the teacher. In this model, students are encouraged to study and observe the events or obstacles they experience in order to get a more thorough and applicable grasp of the issue at hand.

The discovery learning model is critical in structuring students' educational experiences and empowering them to build fundamental and logical thinking skills. According to Kristin (2016), this model allows students to explore their strengths and interests by fulfilling their own curiosity through discovery-based learning. Unlike traditional education, the discovery learning approach encourages students to examine and build their own material for study rather than providing them with specific subject content.

Students adopting the discovery learning model get a greater knowledge of the subject matter and increase their critical and analytical thinking skills by actively seeking information, solving issues, and organizing their understanding into concrete and intelligible forms. Ana (2018), notes that this model promotes student enthusiasm and creativity by transferring the focus of education from the teacher to the student. Students are encouraged to take the initiative in problem-solving and knowledge acquisition, which leads to enhanced involvement and interaction in the educational process.

Numerous research have found that the discovery learning model improves student learning results in mathematics. Hake (1998) and Sugiyono (2017) discovered that students who used the discovery learning model outperformed those who used traditional learning models in terms of learning outcomes. Similarly, Rahmawati et al. (2021), performed a research at a junior high school in Magetan Regency, where the deployment of the discovery learning model significantly increased students' knowledge and test results when compared to a control group receiving traditional teaching.

Collectively, these research findings illustrate the value of the discovery learning model in improving students' outcomes in mathematics education. This model provides a beneficial method to encouraging deeper comprehension, critical thinking, and motivation in the learning process by including students' curiosity, autonomous investigation, and active engagement. It is an alternate teaching technique that can lead to enhanced student performance in mathematics and has the potential for future investigation and adoption in educational contexts.

Furthermore, Hidayatullah et al. (2022), findings demonstrate the potential of the discovery learning model at Madrasah Aliyah Unggul KH.Abd.Wahab Hasbullah in addressing the low learning outcomes reported in geometry. The study's goal was to increase the quality of mathematics learning in the targeted class, which performed poorly during the pre-test phase. The researchers used the discovery learning approach to increase students' acquaintance with mathematical concepts, ultimately aiming to exceed the minimal mastery learning threshold of 75%. Notably, the study produced encouraging results, with a classical completion rate of 68.4% and an average assessment result of 78. These data support the discovery learning model's effectiveness in improving students' mathematics learning.

The purpose of this study was to determine the effectiveness of the discovery learning approach in improving student learning outcomes in the context of geometry transformation material for class IXA at Junior High School 36 Semarang. This study contributes to a deeper knowledge of successful teaching techniques in mathematics education by examining the effects of the discovery learning model on student learning outcomes.

This study seeks to give useful insights into the impact of the discovery learning model in the specific context of geometry transformation and its influence on student learning outcomes, which may contribute to the continual development of mathematics education. It provides a platform for continued investigation and development of successful mathematical teaching practices, eventually benefiting both educators and students in their quest of great mathematics learning experiences.

METHOD

This study was conducted using a quantitative descriptive approach and experimental methods. According to Nuryanti (2019), the experimental method is one of the methods that can be used to accurately test causal hypotheses. The use of experimental methods is conducted to evaluate a learning model's efficacy to determine whether student learning outcomes have improved. In this research, to ascertain the degree of students' comprehension of the subject matter being studied, a pretest was given, and then a posttest was carried out to determine the extent to which student learning outcomes increased after participating in the lesson.

The researchers determined the complete and incomplete student scores using the minimum criteria of mastery learning that had been established as a reference. This minimum criteria of mastery learning is used to assess whether students have achieved the expected competency standards in learning. In this case, students who get scores above or equal to the minimum criteria of mastery learning are considered complete, while Students are regarded as incomplete if their scores fall below the minimum criteria of mastery learning. Using this way of analysis, researchers can analyze and present data in the form of the percentage of students' success in achieving minimum criteria of mastery learning. The minimum criteria of mastery learning used in mathematics is 75. Because of this, students are said to be complete if the results of the posttest are positive, while students are incomplete if the results of the posttest are negative. Learning in class is said to be complete if students who complete it reach 75% of the total number of students. Classical mastery can be calculated using the following formula.

$$Classical\ mastery = \frac{number\ of\ students\ who\ copleted}{total\ number\ of\ students} \times 100\% \quad (1)$$

A pre-experiment design, namely the one-group pre-test-post-test design, was used in this study. Because there was no control group, this design was chosen. The pre-experiment design, as represented in the figure 1 by Fraenkel et al. (2012), entails monitoring the group's performance before and after the therapy. It is crucial to highlight, however, that using a pre-experiment design has inherent limitations. One such disadvantage is the lack of a comparable control group. Without a control group, establishing a clear causal link between the intervention (i.e., the adoption of the discovery learning model) and the observed learning results becomes difficult. Because there was no control group, we were unable to rule out alternate hypotheses or external influences that may have impacted the results. As a result, while the pre-experiment design was appropriate given the study's limits, it is critical to recognize its limitations and exercise care when drawing conclusive conclusions regarding the usefulness of the discovery learning model purely based on this design.

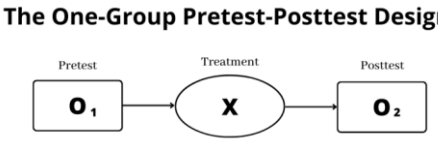

Figure 1. One-Group Pretest-Posttest Research Design

In the one-group pretest-posttest experimental model, the dependent variable is measured in just one group as part of the design. According to Arikunto (2013), in experimental research, there are two variables, namely the dependent variable and the independent variable. While the dependent variable is the one that the researcher observes or measures, the independent variable is the one that the researcher manipulates. The variable that experimental research focuses on is known as the dependent variable and changes in the dependent variable are caused by the influence of the independent variables. The subjects in this study were class IXA students at junior high school 36 Semarang, totaling 31 students. The variable that is independent, or variable X, is the learning model of discovery learning, and the dependent variable, or variable Y, is student learning outcomes.

In the one-group pretest-posttest experimental model, giving a pretest prior to treatment and a posttest following treatment allows for the implementation of the design. The advantage of the pre-experiment one-group pretest-posttest design is being able to measure the distinction between the initial circumstances (pretest) and the final circumstance (posttest) without having to use a control group. In this design, the subject only experiences one treatment, making it easier to measure the effect of the treatment on the variables studied. According to Campbell & Stanley (2015), one-group pretest-posttest designs are the simplest and most commonly used pre-experiment experimental designs in research because of their practicality and ability to save time and money.

This study included 31 students from class IXA at Junior High School 36 in Semarang. The sample size of 31 students in this study was established based on many practical and contextual factors. Furthermore, the researchers carefully analyzed the representativeness of class IXA to guarantee that the study's findings could be adequately extended to a wider student population. The researchers tried to choose a class that closely reflected the larger student population by taking into account aspects such as demographics, academic achievement, and prior knowledge. While the sample size of 31 students is not huge in absolute terms, it is crucial to realize that sample sizes in educational research might vary based on the study topic, context, and accessible resources.

Previous research papers studying comparable issues or applying similar methodology may have also influenced the decision to choose a sample size of 31 students. The mathematics education literature and the discovery learning model may have offered insight into the proper sample sizes employed in comparable research investigations. Finally, a sample size of 31 students was chosen after careful evaluation of practical concerns and the goal of ensuring relevant findings and reasonable generalizability to a broader student population.

The researchers used a written test as the research instrument in this study to assess the participants' pretest and posttest scores. The essay test was created expressly to assess students' knowledge and application of material concepts, with an emphasis on curriculum areas relevant to the discovery learning model intervention. The researchers began creating the essay exam by defining the primary learning objectives and topic areas that were relevant to the study's emphasis. These goals served as the foundation for developing essay questions that effectively assessed students' comprehension and ability to apply the material's ideas in a meaningful way.

The researchers sought the expertise of subject matter experts in mathematics education to improve the quality of the essay test. These experts carefully assessed the first copy of the essay test, offering useful input on the clarity of the prompts, the correctness of the material, and the assessment's suitability for evaluating the targeted learning objectives. Their competence guaranteed that the essay test properly captured the necessary material knowledge and abilities.

Several criteria were taken to determine the validity of the essay test. The researchers performed a content validity study, carefully assessing the essay questions' compatibility with the intended learning objectives. Furthermore, they used criterion-related validity by comparing the students' performance on the essay test to an established criteria, such as a standardized material evaluation. These validity criteria confirmed that the essay exam measured the required knowledge and abilities effectively.

In order to assure consistency in grading and evaluation, reliability metrics were also employed. The researchers gave the assessors or graders particular rubrics or scoring rules to ensure they followed the rubrics or scoring criteria consistently. Furthermore, inter-rater reliability tests were used by having multiple assessors score a portion of the essay replies separately. It correctly measured the students' pretest and posttest scores, giving useful data for assessing the influence of the discovery learning approach on their learning outcomes.

Prior to testing the hypothesis, the data's normality and homogeneity were assessed using preparatory tests. In this research, hypothesis testing was carried out to see whether there

were significant differences and student learning results and the impact of the discovery learning model. Prerequisite testing and hypothesis testing are carried out using software Statistical Package for Social Sciences (SPSS). In this study, the researchers used a paired-sample t-test as their statistical analysis approach. This approach was chosen because it is appropriate for dealing with a single set of participants and assessing variations between pretest and posttest results. The paired-sample t-test was an appropriate option because the study's goal was to analyze the influence of the discovery learning model on student learning outcomes within the same group. The researchers were able to directly compare the average results within the same sample before and after treatment by using the paired-sample t-test. This allowed them to examine the changes in pretest and posttest scores within the group that used the discovery learning model, allowing them to evaluate any significant differences and comprehend how the intervention changed student learning outcomes.

RESULTS AND DISCUSSION

Results

Based on the calculation results, it was determined that the percentage of classical completeness for class IXA on geometry transformation material was 77.42%, and the average evaluation result for class IXA on geometry transformation material was 80.90.

Data from the pretest and posttest are used to produce the research findings. Data analysis shows that the average score for achieving student learning outcomes before utilizing the discovery learning approach was 47.41 out of 31 IXA students, with the smallest score being 30 and the largest score being 60. With a classical completeness percentage of 0%. This means that none of the students achieve mastery in their learning. The score obtained during the pretest is still relatively low and has not reached the minimum criteria for learning completeness. However, the posttest results demonstrate that employing the discovery learning model method enhances students' learning outcomes. The posttest results obtained an average score of 80.90 from 31 students, with the smallest score being 66 and the largest score being 94. With a classical completeness percentage of 77.41%. Classical completeness in the posttest has reached the target that has been set. Table 1 presents the findings of this investigation in more detail.

Table 1. Achievement results of minimum criteria of mastery learning

Value	Research data	
	Pretest	Posttest
N	31	31
$\bar{X}$	47,41	80,90
SD	8,23	7,46
S^2	67,71	55,96
Maks	60	94
Min	30	66

Based on analyzing the pre- and post-test results from studies employing the discovery learning model, the normality test results of the pretest and posttest data are normally distributed. Having a value greater than 0.756, the pretest and posttest data are considered normally distributed. Then do the homogeneity test results, where the results of the homogeneity test on the pretest and posttest have a calculated value of 0.911, Therefore, it can be said that the population is homogeneous.

Based on the "Paired Samples Test" output Table 2, it is known that the sig. (2-tailed) is $0.000 < 0.05$. So it can be concluded that there are differences in the results of the pretest and posttest, which means that there is an effect of using the discovery learning model in improving students' learning outcomes of class IXA junior high school 36 Semarang on geometry transformation material.

Table 2. Paired Samples Test

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pretest - Posttest	-3.34839E1	9.14283	1.64210	-36.83749	-30.13025	-20.391	30	0.000

The N-gain value of 0.61 found in this study shows a moderate improvement in student learning outcomes. N-gain, also known as normalized gain, is a statistic used to assess the success of an intervention or instructional technique by comparing pretest and posttest scores. It measures how much students have improved from their starting level of comprehension. In the context of this study, an N-gain score of 0.61 indicates that students saw a moderate improvement in their knowledge of the geometry transformation content after being exposed to the discovery learning approach. This improvement suggests that the educational technique had a beneficial influence on students' learning results.

It is vital to remember that the interpretation of N-gain values is context and educational domain dependent. N-gain values ranging from 0.4 to 0.7 are generally seen as indicating a moderate improvement in student learning outcomes. As a result, an N-gain value of 0.61 falls within this range, indicating that the application of the discovery learning model resulted in a significant improvement in student knowledge.

The medium improvement shown by the N-gain score shows that students have made considerable progress in their understanding of the geometry transformation subject. This progress can be linked to the discovery learning model's chances for active participation, individual inquiry, and collaborative problem solving. The medium level of development indicates that students have gained a considerable quantity of new information and abilities related to geometric transformations.

Based on the results of the pretest conducted, it was found that none of the students succeeded in achieving the minimum mastery learning. With 3 students in the low category and 28 students in the medium category. Then the posttest is given after learning by applying the discovery learning model, so that the posttest results are obtained by 24 students who achieve the minimum mastery learning. With 7 students in the medium category and 24 students in the high category.

Discussion

The current study's findings are consistent with prior studies that evaluated the usefulness of the discovery learning model in improving student learning outcomes. Hanifah et al. (2017), emphasized the necessity of students individually researching and grasping the subject matter in their pursuit of knowledge through discovery learning. This lends credence to the idea that the discovery learning model encourages students to participate actively in their education, which can lead to a deeper grasp of the content being studied.

Wahyudi and Siswanti (2015), also noted how the method of discovery learning involves students establishing their own perceptions of the information, enabling greater engagement with the material. This is consistent with the current study's findings, which show that students' active participation in discovering geometric transformations using the discovery learning model resulted in enhanced learning outcomes.

By integrating the findings of prior studies with the findings of the current study, a coherent picture of the efficiency of the discovery learning model emerges. The data shows that students have superior learning results when they are actively involved in the learning process, autonomously investigating topics and creating their own knowledge.

Student activeness in learning has a positive impact on improving their learning outcomes. When students are actively involved in the learning process, they are more engaged, pay attention to the subject matter, have higher motivation, and develop a deeper understanding of the concepts being taught. In addition, student activity also contributes to the development of critical skills, increased information retention, and problem solving. Therefore, implementing learning strategies that encourage student activity, such as the discovery learning model, can be an effective way to improve student learning outcomes (Putri et al., 2017) .

This supports the use of the discovery learning model as an effective method to improving student learning in a variety of educational settings.

Table 3. The categorization of learning outcomes based on competency levels

Category	Pretest	Posttest
High	-	7
Medium	-	17
Low	31	7

In the pretest, none of the students who achieved the minimum mastery learning. After implementing discovery learning, there were 24 students who achieved the minimum mastery learning. Students who get a score of 0-74 are in the low category, while students who get a score of 75-85 are in the medium category and students who get a score of 86-100 are in the high category. From the pretest results obtained, 31 students were in the low category. Then, in the posttest, results were obtained for 7 students in the low category, 17 students in the medium category and 7 students in the high category. Data analysis demonstrated a consistent trend across the majority of students, demonstrating a favorable association between the use of the discovery learning model and improved learning results. These findings not only confirm the discovery learning model's effectiveness, but also emphasize its potential as a helpful educational tool in the context of geometry transformation education.

This study has substantial practical implications for mathematics education by adding the discovery learning approach into math education, especially for the geometry transformation content in class IXA at junior high school 36 Semarang. To begin, the findings highlight the discovery learning model's success in creating active and student-centered learning experiences. Students are encouraged to actively participate in the learning process, participate in group discussions, and investigate the topic of geometric transformations. This change toward student-centered learning has the potential to increase students' motivation, passion, and ownership of their learning, resulting in better learning outcomes.

The adoption of the discovery learning methodology in math education has practical benefits for teaching geometry transformation content (Alkhateeb & Al-Duwairi, 2019). Geometry is typically seen as abstract and difficult by students. However, by using the discovery learning model, teachers may give students hands-on experiences, allowing them to explore geometric ideas through real-world examples, interactive activities, and collaborative problem-solving. This technique assists students in developing a better knowledge of geometric transformations and their applications, making the learning experience more interesting and engaging.

The findings also emphasize the significance of combining a variety of learning tools into mathematics instruction, such as technology, peers, group work, and everyday life. Students have access to a greater range of resources and views by broadening their learning sources, increasing their grasp of geometric transformations. This method supports the objective of training students to apply mathematical principles to real-world problems and encourages the development of critical thinking and problem-solving abilities. Teachers play a key role in supporting student-centered learning experiences and offering advice and support during the discovery process (Goodyear & Dudley, 2015). Teachers play an important role in creating an atmosphere that supports active student engagement, investigation, and problem-solving in the framework of the discovery learning approach. They act as facilitators, helping students

through the learning process, offering thought-provoking questions, and giving the materials and scaffolding they need to comprehend (Fachrunisa et al., 2022). Teachers may boost student involvement in the learning process by taking a student-centered approach and utilizing the discovery learning model. Through hands-on investigation and discovery, this approach enables students to take an active part in building their knowledge and increasing their grasp of geometric ideas (DelMas et al., 1999). Overall, the effective adoption of the discovery learning model in this study not only improved student learning outcomes but also emphasized the critical role of teachers in building a student-centered learning environment. By adopting this technique, teachers may encourage their students' active engagement, motivation, and a greater comprehension of the subject matter.

While the findings of this study significantly support the discovery learning model's efficacy in improving student learning outcomes, it is vital to recognize that other instructional techniques or factors may also contribute to increased student performance. Exploring these choices and analyzing their potential consequences is beneficial for future research and teaching approaches. It is crucial to explore the possibilities of instructional techniques that include technology for future research and instructional practices in addition to investigating alternative instructional approaches. Technology has the potential to improve student learning outcomes while also offering interesting and interactive learning experiences (Wulandari et al., 2022).

One such strategy is the incorporation of educational technology tools and resources into the classroom. This can include interactive simulations, instructional software, virtual reality experiences, online collaboration platforms, and multimedia presentations. These technologies can give students immersive and hands-on learning experiences that encourage active investigation and greater comprehension of subjects. Technology can also offer individualized and adaptable learning experiences (Puspita et al., 2022). Students can receive individualized training and feedback based on their unique requirements and progress with the use of educational tools and platforms. Adaptive learning systems may assess student performance and adjust the content and pace of education to improve learning results.

Technology enables access to a diverse range of instructional tools and materials outside of the typical classroom context (Pahmi et al., 2023). Students can obtain knowledge, do research, and explore real-world applications of ideas being learned by using online databases, digital libraries, and instructional websites. This increases students' access to learning materials and encourages autonomous and self-directed study. However, it is critical to note that technological integration should be strategic and associated with particular learning objectives (Puspita et al., 2022). Without a defined instructional design or pedagogical framework, just adopting technology may not result in enhanced learning results. As a result, future study should investigate the efficacy of various instructional technology tools and techniques, establish best practices for their integration, and assess their influence on student accomplishment.

Exploring the possibilities of instructional approaches that use technology allows educators to exploit its benefits to improve student learning outcomes, encourage engagement, and give chances for individualized and self-directed learning. Future study in this field can help to establish successful technology-enhanced educational approaches that respond to the different requirements and preferences of students in the digital era.

CONCLUSION

The outcomes of the data analysis reveal that the use of discovery learning models with geometry transformation material in mathematics learning for class IXA junior high school 36 Semarang greatly improves student learning outcomes. The average student evaluation results demonstrate this, which increased to 80.90 from previously only 47.41, as well as the percentage of classical completeness, which reached 77.42%. In addition, there was an increase in pretest and posttest scores of 0.61, which is included in the moderate category. The results

of the paired sample t-test support these findings, which have a moderate significance value. From the research results show, In the pretest, none of the students who achieved the minimum mastery learning. After implementing discovery learning, there were 24 students who achieved the minimum mastery learning. From the pretest results obtained, 31 students were in the low category. Then, in the posttest, results were obtained for 7 students in the low category, 17 students in the medium category and 7 students in the high category. As a consequence of the findings of this study, show that the discovery learning approach improves student learning outcomes in this particular environment. Teachers play a crucial role in assisting students to learn in a student-centered manner. They advise and encourage students during the exploration process. Teachers establish a classroom environment that encourages students to participate, investigate, and solve issues utilizing the discovery learning approach. They work as facilitators, asking students probing questions and providing them with the resources they need to grasp. Finally, while the discovery learning model has been shown to be helpful in enhancing student learning outcomes, it is crucial to examine different instructional techniques and the possibilities of utilizing technology in future research and teaching practices. The incorporation of educational technology tools may create interactive and individualized learning experiences, provide access to resources, and encourage autonomous study. Future study should focus on the usefulness of instructional technology and the best techniques for integrating it to improve student accomplishment in the digital era.

REFERENCES

Alkhateeb, M. A., & Al-Duwairi, A. M. (2019). The Effect of Using Mobile Applications (GeoGebra and Sketchpad) on the Students' Achievement. *International Electronic Journal of Mathematics Education*, *14*(3), 523-533. https://doi.org/10.29333/iejme/5754

Ana, N. Y. (2018). Penggunaan Model Pembelajaran Discovery Learning dalam Peningkatan Hasil Belajaran Siswa di Sekolah Dasar [The Use of the Discovery Learning Learning Model in Improving Student Learning Outcomes in Elementary Schools]. *Jurnal Imiah Pendidikan dan Pembelajaran*, *2*(1). https://doi.org/10.23887/jipp.v2i1.13851

Arikunto, S. (2013). *Prosedur penelitian: Suatu pendekatan praktik [Research procedure: A practical approach]*. Jakarta: Rineka Cipta.

Campbell, D. T., & Stanley, J. C. (2015). *Experimental and quasi-experimental designs for research*. Ravenio books.

DelMas, R. C., Garfield, J. B., & Chance, B. L. (1999). A model of classroom research in action: Developing simulation activities to improve students' statistical reasoning. *Journal of Statistics Education*, *7*(3). https://doi.org/10.1080/10691898.1999.12131279

Fachrunisa, A., Kuncoro, K. S., & Arigiyati, T. A. (2022). Development of Interactive E-Modules Assisted by The Kvisoft Flipbook Maker Application on Algebraic Forms Grade VII. *Journal of Mathematics and Mathematics Education*, *12*(1). https://doi.org/10.20961/jmme.v12i1.61091

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education*. New York: McGraw-hill.

Goodyear, V., & Dudley, D. (2015). "I'ma facilitator of learning!" Understanding what teachers and students do within student-centered physical education models. *Quest*, *67*(3), 274-289. https://doi.org/10.1080/00336297.2015.1051236

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, *66*(1), 64–67. http://dx.doi.org/10.1119/1.18809

Hanifah, Ummu, & Wasitohadi. (2017). Perbedaan Efektivitas Antara Model Pembelajaran Discovery dan Inquiry Ditinjau Dari hasil Belajar IPA Siswa [Differences in Effectiveness Between Discovery and Inquiry Learning Models in View of Student Science Learning Outcomes]. *E-Jurnal Mitra Pendidikan*, *2*(1), 92–104. Retrieved from https://e-jurnalmitrapendidikan.com/index.php/e-jmp/article/view/60

Hidayatullah, A. M., Satiti, W. S., & Chotimah, C. (2022). Peningkatan Hasil Belajar Siswa dengan Model Discovery Learning Pada Materi Transformasi Geometri Kelas XI MA/SMA [Improving Student Learning Outcomes with the Discovery Learning Model in Geometry Transformation Material for Class XI MA/SMA]. *Journal of Education and Management Studies*, *3*(3), 21–24. Retrieved from http://www.ojs.unwaha.ac.id/index.php/joems/article/view/298

Kristin, F. (2016). Analisis Model Pembelajaran Discovery Learning dalam Meningkatkan Hasil Belajar Siswa SD [Analysis of the Discovery Learning Learning Model in Improving Learning Outcomes of Elementary School Students]. *Jurnal Pendidikan Dasar PerKhasa*, *2*(1), 80–98. https://doi.org/10.31932/jpdp.v2i1.25

Martini, J. (2014). *Kesulitan Belajar:Perspektif, Asesmen, dan Penanggulangan [Learning Difficulties: Perspective, Assessment, and Countermeasures]*. Bogor: Ghalia Indonesia.

Nuriyah, R., Yuliati, L., & Supriana, E. (2018). Eksplorasi Penguasaan Konsep Menggunakan Experiential Learning pada Materi Hukum Newton [Exploration of Concept Mastery Using Experiential Learning on Newton's Law Material]. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *3*(10), 1270–1277. https://doi.org/http://dx.doi.org/10.17977/jptpp.v3i10.11608

Nuryanti, R. (2019). Penggunaan Model Pembelajaran Kooperatif dengan Strategi Team Games Tournament (TGT) untuk Meningkatkan Hasil Belajar Matematika pada Materi Bilangan Romawi bagi Siswa Tunarungu Kelas IV SDLB [The Use of Cooperative Learning Models with Team Games Tournament (TGT) Strategy to Improve Mathematics Learning Outcomes in Roman Numbers Material for Deaf Students in Grade IV SDLB]. *Jurnal Asesmen Dan Interverensi Anak Berkebutuhan Khusus*, *20*(1), 40–51. https://doi.org/10.17509/jassi.v19i1.22711

Pahmi, S., Hendriyanto, A., Sahara, S., Muhaimin, L. H., Kuncoro, K. S., & Usodo, B. (2023). Assessing the Influence of Augmented Reality in Mathematics Education: A Systematic Literature Review. *International Journal of Learning, Teaching and Educational Research*, *22*(5). https://doi.org/10.26803/ijlter.22.5.1

Puspita, R., Yani, E., Dinnisa, K., Kusumaningrum, B., Kuncoro, K. S., Ayuningtyas, A. D., & Irfan, M. (2022). Interactive Math Path: Permainan Ular Tangga Berbasis Etnomatematika [Interactive Math Path: Ethnomatematics Based Snakes and Ladders Game]. *UNION: Jurnal Ilmiah Pendidikan Matematika*, *10*(1), 93-102. https://doi.org/10.30738/union.v10i1.12139

Putri, I. S., Juliani, R., & Lestari, N. I. (2017). Pengaruh Model Pembelajaran Discovery Learning Terhadap Hasil Belajar Siswa dan Aktivitas Siswa [The Effect of Discovery Learning Models to Learning Outcomes Students and Students Activities]. *Jurnal Pendidikan Fisika*, *6*(2), 91–94. https://doi.org/10.22611/jpf.v6i2.6927

Rahayu, T. D. (2013). Analisis Kesalahan Siswa Kels XI TKJ SMK Kuncup Samigaluh dalam Menyelesaikan Soal Uraian Pada Materi Limit dan Turunan [Error Analysis of Class XI TKJ SMK Kuncup Samigaluh in Solving Description Questions on Limits and Derivatives Material]. *Union: Jurnal Ilmiah Pendidikan Matematika*, *1*, 41–52. https://doi.org/10.30738/.v1i1.7

Rahmat, P. S. (2016). Peran Pendidikan dalam Membentuk Generasi Berkarakter Pancasila [The Role of Education in Forming a Generation with Pancasila Character]. *Jurnal Penelitian Pendidikan*, *3*(2), 1–15. https://doi.org/10.25134/pedagogi.v3i2.1161

Rahmawati, S., Masykuri, M., & Sarwanto, S. (2021). The effectiveness of discovery learning module classification of materials and its changes to enhance critical thinking skills. *Jurnal Inovasi Pendidikan IPA*, *7*(1). https://doi.org/10.21831/jipi.v7i1.33253

Rusli, R. (2020). Efektifitas Model Pembelajaran Discovery Learning dalam Meningkatkan Hasil Belajar PAI di Sekolah Menengah Pertama [The Effectiveness of the Discovery Learning Learning Model in Improving PAI Learning Outcomes in Junior High Schools]. *SEUNEUBOK LADA: Jurnal Ilmu-Ilmu Sejarah, Sosial, Budaya Dan Kependidikan*, *7*(1), 107–117. https://doi.org/10.33059/jsnbl.v7i1.2252

Sanjaya, W. (2010). *Pembelajaran dalam implementasi kurikulum 2013 [Learning in implementing the 2013 curriculum]*. Kencana Prenada Media Group.

Sugiyono. (2017). *Metode penelitian kuantitatif, kualitatif, dan R&D [Quantitative, qualitative, and R&D research methods]*. Bandung: Alfabeta.

Wahyudi, W., & Siswanti, M. C. (2015). Pengaruh Pendekatan Saintifik Melalui Model Discovery Learning dengan Permainan Terhadap Hasil Belajar Matematika Siswa Kelas 5 SD [The Effect of a Scientific Approach Through the Discovery Learning Model with Games on the Mathematics Learning Outcomes of Grade 5 Elementary School Students]. *Scholaria : Jurnal Pendidikan Dan Kebudayaan*, *5*(3), 23. https://doi.org/10.24246/j.scholaria.2015.v5.i3.p23-36

Wulandari, D., Arcana, I. N., & Kuncoro, K. S. (2022). Pengembangan Instagram reels pembelajaran pokok bahasan persamaan garis lurus untuk SMP [Development of Instagram reels for learning the subject of straight line equations for junior high school]. *UNION: Jurnal Ilmiah Pendidikan Matematika*, *10*(1), 1-14. https://doi.org/10.30738/union.v10i1.12138

Yuniarti, T. (2020). Meningkatkan Aktivitas dan Hasil Belajar Siswa SMP pada Materi Sistem Respirasi pada Manusia melalui Model Pembelajaran Student Teams Achievement Divisions [Improving the Activities and Learning Outcomes of Junior High School Students on Respiratory System Material in Humans through the Student Teams Achievement Divisions Learning Model]. *Pedagonal : Jurnal Ilmiah Pendidikan*, *4*(2), 91–96. https://doi.org/10.33751/pedagonal.v4i2.2597

Zakaria, E., Chin, L. C., & Md. Yusoff Daud. (2010). The effects of Cooperative Learning on Students' Mathematics Achievement and Attitude Towards Mathematics. *Journal of Social Sciences*, *6*(2), 272–275. https://doi.org/10.3844/jssp.2010.272.275