International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

https://gssrr.org/index.php/JournalOfBasicAndApplied/index

Students' Abilities and Activities Learning in Mathematics at Junior High School: The Discovery Learning Model Using a Scientific Approach

Happy Lumbantobing[a]*, Mayor M. H. Manurung[b], Pitriana Tandililing[c], Agnes Teresa Panjaitan[d], Rina Ananta Sumawardani Sitepu[e]

[a,b,c,d,e]*Department of Mathematics Education, Faculty of Teacher Training and Education , University of Cenderawasih, Jayapura, PO Box 99333, Indonesia*

[a]*Email: happytobing1968@gmail.com;* [b]*Email: mayormanurung16@gmail.com;* [c]*Email: fitrianawill@gmail.com;* [d]*Email: agnesteresapanjaitan@fkip.uncen.ac.id;* [e]*Email: sumawardanisitepu@gmail.com*

Abstract

This study has analyzed students' abilities and learning activities by employing the discovery learning model within a scientific approach. We conducted the research in two junior high schools, which included a total sample of 51 individuals. We employed a research methodology utilizing participatory observation techniques to analyze students' learning activities at each educational stage in alignment with the scientific approach. The findings indicated that students are able to build knowledge by using their own sentences without looking at the textbook definition, deduce mathematics concepts based on their work, conclude in narrative rather than formula or calculation, and apply concepts to problem solving. Furthermore, we categorized student learning activities at each stage as good and excellent. The discovery learning model through a scientific approach encourages students to explore mathematical concepts through hands-on activities and problem-solving, fostering a more profound understanding of the subject. Students are able to develop critical thinking skills and a greater enthusiasm for learning mathematics.

Received: 4/20/2025
Accepted: 6/1/2025
Published: 6/13/2025

---

* Corresponding author.

Keywords: Abilities; learning activities; discovery learning model; scientific approach.

1. Introduction

Students' ability to solve problems in the form of problem-solving in the field of mathematics is still weak. This can be seen from the results of the mathematics competition on the Programme for International Student Assessment (PISA), which placed Indonesia 69th out of 80 countries, according to the [1]. Indonesia's mathematics score is 366 out of the maximum achievable score of 600. The score deviates significantly from the mean score of 437.9. In comparison to Indonesia's PISA score in 2018, this score has exhibited a decline of 13 points. The cause of this low student ability is that mathematics learning in schools does not familiarize students with problems in the form of problem solving, learning that is too theoretical and less contextual. In addition, learning in the classroom still tends to be teacher-centered, so students do not actively apply their knowledge to everyday life problems. This lack of engagement not only hinders their understanding of mathematical concepts but also limits their ability to think critically and solve real-world problems. To address this issue, educational reforms should prioritize more interactive and contextual learning approaches that encourage students to apply their knowledge practically.

Educators must construct classroom learning with suitable models and methodologies to enhance student engagement in the learning process. The learning process must actively engage and motivate learners to participate, enabling them to develop knowledge internally [2]. The activeness of student learning serves as an indicator for successful education, fostering maturity, independence, and responsibility in individuals. The pedagogical model and methodology utilized by educators in the classroom profoundly affect the engagement of students in the learning process. The choice of pedagogical approaches, such as collaborative learning, project-based learning, and inquiry-based instruction, can significantly enhance student involvement and enthusiasm. By creating an interactive and supportive environment, educators can empower students to take ownership of their learning and cultivate critical thinking skills that are essential for their future success.

According to [3] and [4], cooperative learning models employing a scientific learning approach can enhance student engagement in learning activities. If we make learning more captivating, students will engage more actively. One initiative to enhance the appeal of learning is the implementation of several cooperative learning models utilizing a scientific pedagogical approach. The integration of a cooperative learning model with a scientific approach might enhance students' motivation and engagement in learning activities. This occurs because the combination does not place pupils in a passive role, merely listening to the teacher's explanations [5]. This approach encourages active participation, critical thinking, and collaboration among students, fostering a more dynamic learning environment. As a result, learners are more likely to retain information and develop a more profound understanding of the subject matter.

The discovery learning model is a variant of cooperative learning models. The discovery learning model encompasses five essential parts of the learning phases: stimulation, data collection, data processing, verification, and generalization. Implementing these learning phases can augment students' participation, competencies, and creativity in education. Discovery learning engages students actively in the educational process, fostering enjoyment in independently uncovering concepts with assistance from peers and educators, as noted by [6, 7, 8]. These investigations emphasize the value of collaborative environments where students can explore and construct knowledge together, ultimately leading to deeper understanding and retention of concepts. By integrating discovery learning with a scientific approach, educators can create a dynamic classroom atmosphere that nurtures critical thinking and problem-solving skills. Sufairoh's research [9] indicates that the scientific approach is a cooperative learning paradigm appropriate for mathematics instruction. The discovery learning model emphasizes the active engagement of students in inquiry and problem-solving activities. Active students can locate and categorize their discoveries based on their relevant conceptual frameworks. Moreover, the discovery model enhances the retention of knowledge among students and substantially improves learning efficacy. Reference [10] support these findings by demonstrating that students who engage in discovery learning not only develop a more profound understanding of mathematical concepts but also exhibit greater motivation and confidence in their abilities. This aligns with the notion that cooperative learning environments foster collaboration and communication, essential skills for effective problem-solving in mathematics. Moreover, these skills are crucial not only in academic settings but also in real-world applications. By cultivating a collaborative atmosphere, educators can empower students to tackle complex mathematical problems more effectively, ultimately leading to improved academic outcomes and a lifelong appreciation for learning.

The discovery learning model enhances students' cognitive processes by maximizing their potential. By optimizing their potential, the discovery learning model improves students' cognitive processes. This model can be implemented in an autonomous learning program. The independent learning curriculum grants pupils the liberty to independently pursue information. The autonomous learning curriculum promotes student exploration of information through experimentation and activities aligned with a scientific approach. The discovery learning model and the scientific approach are mutually reinforcing. The relationship is evident in the phases of the scientific approach: problem formulation, hypothesis generation, data collection, data analysis, and decision-making. Reference [11] highlight the importance of integrating these approaches to enhance critical thinking and problem-solving skills among students. By engaging in this iterative process, learners become more adept at asking questions and seeking answers, fostering a deeper understanding of the scientific principles at play.

The discovery learning model influences students' thinking processes by optimizing their potential. The discovery learning model influences students' thinking processes by optimizing their potential. One can implement this model in an independent learning curriculum. Due to the independent learning curriculum, students have the freedom to autonomously explore knowledge. The independent learning curriculum encourages students to freely explore knowledge by trying and experimenting with activities based on an approach that is in accordance with the scientific approach. The discovery learning model and the scientific approach support each other. This can be seen in the stages of the scientific approach, namely formulating problems, proposing hypotheses, collecting data, analyzing data, and making decisions [11].

These scientific approach stages foster a student-centered environment in which learners actively participate in independent discovery and knowledge production. This promotes the utilization of critical, logical, and analytical thinking skills among students, alongside the capacity for successful collaboration and communication within groups [12]. The scientific approach aims to facilitate a comprehensive understanding of scientific ideas through experimentation, observation, and thought. The stages of the scientific approach typically include observation, question formulation, experimentation, data collection and analysis, conclusion drawing, and result communication.

The discovery learning paradigm and the scientific approach can be characterized succinctly. The integration of the discovery learning model with the scientific approach enhances students' problem-solving capabilities and elevates their engagement in learning activities. According to [4 ,13], the integration of the discovery learning model with the scientific approach can yield more optimal learning outcomes.

Some of the study results that are in accordance with this are as follows: Aufa and Taufik concluded that the application of a scientific approach can improve the results of students' activities and learning outcomes [14]. Novio and Mariya suggest that applying a scientific approach to the discovery learning model can improve students' activities and learning outcomes [15]. Applying the discovery learning model can maximize students' abilities to gather information, comparing, categorizing, analyzing, integrating, and drawing conclusions. This shows that with this combination, there is an increase in student learning activities in exploration activities, namely student activities that involve studying, examining, and processing something new that can enhance insight and build upon previous knowledge.

2. Research Methods

2.1. Research Methods

This study employs a descriptive research design utilizing a quantitative methodology. The descriptive method is employed to analyze and delineate students' learning activities based on seen data. Descriptive research methods utilizing quantitative methodologies seek to furnish a comprehensive comprehension of observable phenomena [16]. It is essential to delineate and elucidate the students' learning activities that transpire during the execution of research in the classroom. This study seeks to delineate the activities undertaken by students when employing the discovery learning model, executed through a scientific method. The quality of student learning activities was evaluated by a Likert scale to assess the extent of student engagement during the learning process, as conducted by [17]. The research data analysis results were interpreted in alignment with the facts and circumstances encountered during the study, as noted by [16].

2.2. Sample

The research was conducted on class VII in two schools, namely SMP Negeri 11 Kota Jayapura and SMP YPPK St. Paulus Abepura. The selection of classes from each school was done by purposive sampling technique. While the sample members consisted of all students from both classes, namely 26 students of class VII-A SMP YPPK St. Paulus Abepura and 25 students of class VII-D SMP Negeri 11 Jayapura.

2.3. Research Design

Descriptive research is applied in this study because researchers aim to describe or identify a phenomenon that is the center of the study without manipulating it. Participatory observation using observation sheets was carried out to obtain data on student learning activities. Learning using the discovery learning model with a scientific approach was carried out several times in both classes, and data collection was carried out in each lesson.

2.4. Student Learning Activity Observation Sheet

Observers utilize the student learning activity observation sheet as a guideline to evaluate the quality of student learning activities that occur during the learning process, which employs the discovery learning model alongside a scientific approach. This observation sheet measures individual and group student learning activities based on the phases of the discovery learning model and the stages of activity in the scientific approach. Indicators of student learning activities are developed and adopted as the main learning experiences listed in Pemendikbud Number 81a of 2013 [18]. The quality of each student's learning activities is divided into 4 categories, ranging from the lowest quality up to the highest.

3. Analysis of Data

Through the utilization of a Likert scale, we were able to convert the qualitative data regarding the student learning activities into a quantitative format. After processing and analyzing the quantitative results, we proceed to interpret them. On top of that, we determine the score for student learning activities by utilizing the following formula:

$$\text{Student learning activity score (p)} = \frac{\sum \text{score obtained}}{\sum \text{maximum score}}.$$

The score is then divided into four distinct categories. The categories that have been adopted from [19] are as follows: if the score is $p \leq 40$, then student learning activity is fair; if the score is $40 < p \leq 60$, then student learning activity is good; if the score is $60 < p \leq 80$, then student learning activity is very good; and if the score is $80 < p \leq 100$, then student learning activity is excellent.

4. Results

4.1. Students' Ability to Develop Concepts and Solve Problems

The scientific approach can be combined with the discovery learning model to encourage students to construct mathematics concepts or information independently and to solve problems through the process of problem solving. This advantage is due to the fact that the integration of the two in education facilitates the development of critical thinking, analytical thinking, and scientific thinking abilities in students. Furthermore, both methodologies necessitate assignments that involve data collection, data analysis, data interpretation, and conclusions to furnish students with novel information.

The following are a few examples of research results that illustrate the ability of students to construct concepts and identify solutions to challenging situations in the context of problem solving.

1. Write down the definition of a central angle.

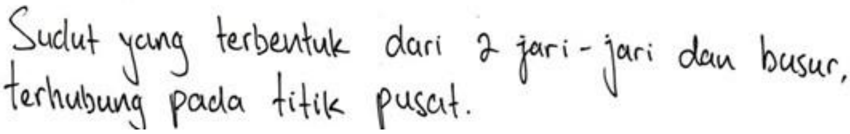


Figure 1

The students can write the definition of central angle based on their observations. A student writes down that a central angle is an angle formed by two radii and one arc connected at a central point. What is proud is that from the results of observations and interviews with students, the students compiled the definition of the central angle based on their knowledge, not from the understanding written in the textbook. This approach demonstrates their ability to synthesize information and encourages more profound engagement with the material. By articulating their understanding in their own words, the students develop a more meaningful connection to the concept of a central angle.

2. Write down the definition of an inscribed angle.

The same thing is seen that students are also able to write the definition of an inscribed angle by building knowledge within themselves through the process of scientific discovery. A student writes down that an inscribed angle is an angle formed by two chords and an arc connected at one point.

Students are able to build knowledge about inscribed angles by using their own sentences without looking at the definition in the textbook. This approach enhances their understanding of the concept and encourages critical thinking as they relate the definition to their own experiences and observations. By articulating their thoughts in their own words, students are more likely to retain and apply the knowledge in various mathematical contexts.

3. What is the distinction between the central angle and the inscribed angle of a circle?

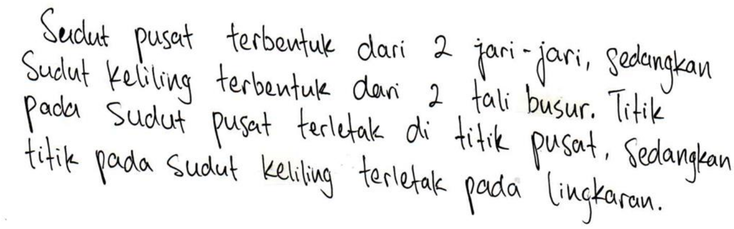


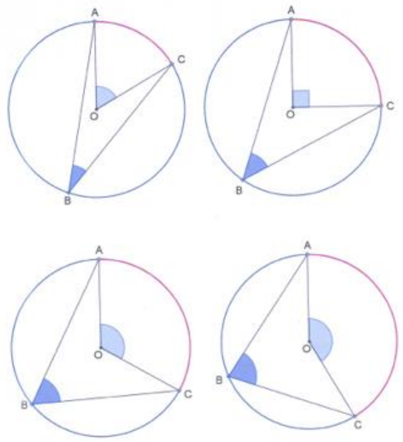
Figure 2

A student writes down that the distinction between the central angle and the inscribed angle of a circle is that the central angle is formed by two radii, while the inscribed angle is formed by two chords. Then the central angle's vertex is at the circle's center, while the inscribed angle's vertex is on the circle.

Next, the researchers wanted to test the students' level of understanding more deeply. The researcher asked and interviewed students about the distinction between the central angle and the inscribed angle of a circle. The results from the answer sheets, observations, and interviews with students showed that students were able to describe and answer well the differences between the central angle and inscribed angle of a circle.

The evidence indicates that integrating the discovery learning model with scientific approaches can encourage students to think critically, innovate, and build confidence. This confidence enhances their understanding of geometric concepts and fosters a positive attitude toward learning mathematics as a whole. As students become more engaged and capable of articulating these distinctions, they are better prepared to tackle more complex topics in geometry and beyond.

4. Researchers ask the students to observe and measure several central angles, as well as inscribe angles from some circles below. The results are written, and the data are analyzed to conclude the relationship between the size of the central angle and the inscribed angle. We present one of the students' results below.



No	Sudut Pusat	Sudut Keliling	Hasil dari sudut pusat dan sudut keliling
1	60°	30°	Besar sudut pusat adalah ..2.. kali besar sudut keliling
2	90°	45°	Besar sudut pusat adalah ..2... kali besar sudut keliling
3	120°	60°	Besar sudut pusat adalah ..2... kali besar sudut keliling
4	150°	75°	Besar sudut pusat adalah ..2... kali besar sudut keliling

Dari hasil pengamatan pada tabel di atas, buat kesimpulan tentang hubungan besar sudut pusat dan besar sudut keliling.

Hubungannya adalah besar sudut pusat 2 kali lebih besar dari sudut keliling jika menghadap busur yang sama.

Figure 3

Students are able to deduce the relationship between the magnitude of the central angle and the inscribed angle of a circle based on the findings of their work above. They conclude in narrative rather than in a mathematical formula or calculation. In their observations, students note that as the central angle increases, the inscribed angle also grows proportionally. This relationship helps them to conclude that the central angle is always twice the measure of the inscribed angle when both angles face the same arc in a circle.

5. A flower garden is circular with a radius of 420 cm. There are two types of flowers planted in the garden: rose and jasmine flowers. Jasmine flowers is planted in the area of the radius with a central angle of 30°, meanwhile, rose flowers in the rest of the area.

a. Determine the area of the garden where jasmine flowers are planted.

b. Determine the length of the arc planted with rose flowers.

One of the students' work results is presented below.

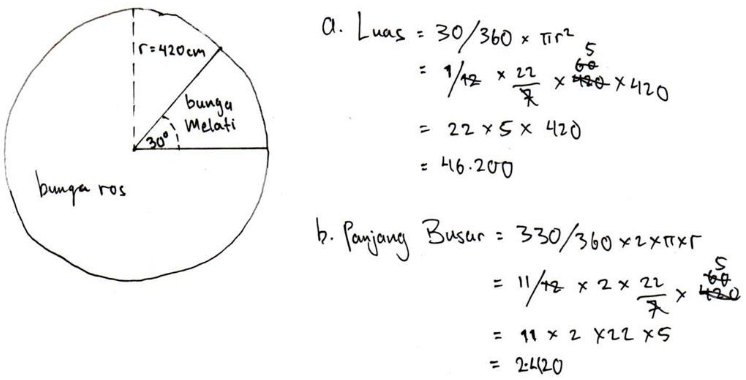


Figure 4

Based on the students' answers, it can be seen that students are able to apply the concepts of central angle, inscribed angle, sector, and arc of an angle to determine the area of a garden that is part of a circle. They are able to distinguish which sector and arc where the flowers are planted. This understanding not only demonstrates their grasp of geometric principles but also enhances their ability to solve real-world problems related to landscaping and garden design. By applying these concepts effectively, students can create visually appealing and mathematically sound garden layouts.

4.2. Students' Learning Activity in the Application of the Discovery Learning Model with a Scientific Approach

The processes of observing, questioning, obtaining information, associating, and communicating with others are some of the student learning activities that were under consideration for this study. We derive these activities from the various stages of the scientific approach. We use four different indicators to categorize all learning activities based on their quality. In general, the learning activities that students engage in while they observe are activities that involve finding certain patterns, characteristics, or attributes of certain images or objects. Students have not yet achieved a comprehensive understanding as a result of this action. Additionally, some activities that involve observation require a more in-depth and critical examination than the previously described activities. Within the context of this observation activity, the score for the learning activity is 77.94. The very good category includes the score.

Students' learning activities in questioning activities typically consist of activities that involve asking simple questions but do not yet reflect deep thinking; activities that involve asking questions that cover several aspects discussed but have not explored concepts in depth; and activities that involve asking more in-depth questions with a better understanding of the topic or concept and attempting to link different concepts. There is a score of 73.04 for the learning activity that involves questioning activities. This score is considered to be in the very good category.

Usually, learning activities in information gathering involve collecting data carefully in accordance with provided procedures. However, there are still some mistakes and activities that carefully collect data in accordance with the provided procedures and directions, yielding accurate results. With regard to the actions that include obtaining information, the learning activity score is 82.84. This score falls into the excellent category.

Student learning activities related to association take the form of critically analyzing various aspects of the properties or data obtained, but they have not yet explored the concept in depth. Additionally, there are activities designed to conduct a fairly in-depth critical analysis that involves identifying various relationships, patterns, and properties of existing data. The associated activity gives the learning activity a score of 75.98. The score falls within the very good category.

Learning activities in communicating activities are generally in the form of communicating information, ideas, and thoughts, but still less clear and unstructured, communicating data, ideas, and thoughts. However, the messages still require improvement in terms of clarity and structure. Communicating information clearly, is structured, effective, and easy to understand. The score of a communication's effectiveness is determined by how clearly, structured, and easy to understand the information is conveyed. The score for student learning activities in communicating activities is 76.47. This score falls into the very good category.

Furthermore, the description of student learning activeness based on the stages of the scientific approach is shown in the diagram below.

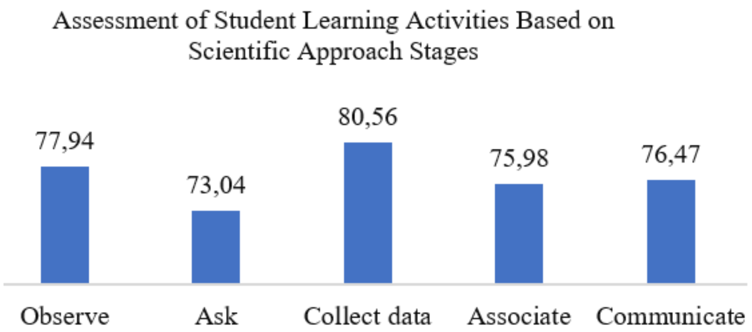


Figure 5

5. Discussion

The research has provided a description of the active learning and participation of students in mathematics education, particularly with regard to circle content. The discovery learning model, which employs a scientific approach, enhanced the learning process. The stages of the scientific approach activities used to study student activeness include observing, questioning, collecting data, associating, and communicating. This student's activeness was analyzed based on these stages. Students are able to build their knowledge on their sentences, and they are also able to solve difficulties via problem-solving, as demonstrated by the results of their work. The syntax of the discovery learning model aligns with the stages of the scientific approach, [4 ,13].

The active participation of students in the learning process throughout the entirety of the scientific learning approach is included in both the good and outstanding evaluation categories. This is because the scientific approach and the discovery learning model complement each other. Both emphasize active student learning, are student-centered, and encourage students to think scientifically and analytically in the process of independently generating new knowledge. These are some of the parallels that exist between the scientific approach and the discovery learning model. According to the research findings of [20], scientific approach produces student-centered learning, in which students actively develop concepts with their thinking and avoid memorizing notions (verbalism). This research is in accordance with the findings of the previous study. The results indicated that the highest learning activeness score occurred in data collection activities. This happens because students are curious and like to use physical skills to collect data through measurement. In addition, visualization using interactive GeoGebra media also increases student interest in learning and improves learning activeness, which can positively impact student learning outcomes. This is in accordance with the results of research from [21], [22, 23, 24], which say that the use of GeoGebra media can increase student interest in learning, student learning activeness, and student learning outcomes. Then the lowest student learning activeness occurs in questioning activities. Students exhibit the lowest level of learning activity during questioning activities. This is because they may feel hesitant or unsure about asking questions, and they still lack the courage to express their opinions. Observations and interviews reveal that students are not accustomed to actively asking questions. This is in accordance with the results of research from [24, 21, 23] which say that the use of media can increase student interest in learning, student learning activeness, and student learning outcomes.

6. Limitation

This study is subject to several limitations. Initially, the selection of sample schools and instructional materials remains restricted. Furthermore, the utilization of the discovery learning model with a scientific approach requires a longer time frame for instruction. Hence, additional investigation is necessary.

7. Conclusion

This study examines students' abilities and their levels of participation in learning by implementing the discovery learning model alongside a scientific approach. The integration of the discovery learning model with the scientific approach is well-suited for fostering students' ability to freely construct knowledge, as both methods complement and enhance one another. The study findings indicate that students are able to build knowledge by using their own sentences without looking at the textbook definition, deduce mathematics concepts based on their work, conclude in narrative rather than formula or calculation, and apply concepts to problem solving. Furthermore, student learning activities during the stages of the scientific approach fall under the categories of good and excellent. The most effective learning activities took place during the data collection stage, while the least effective learning activities took place during the questioning stage. Furthermore, implementing the discovery learning model with a scientific approach enables students to autonomously develop new knowledge and effectively tackle problem-solving tasks.

References

[1] OECD, "The State of Learning and Equity in Education," *PISA 2022 Results*, vol. 1, 2023. [Online]. Available: https://oecdch.art/a40de1dbaf/C108.

[2] G. M. Bodner, "Constructivism: A Theory of Knowledge," *J Chem Educ*, vol. 63, 1986.

[3] D. A. Uswatun and R. Widiyanto, "Analisis Aktivitas Peserta Didik dalam Pembelajaran Berbasis Scientific Approach di Sekolah Dasar sebagai Implementasi 21st Century Skills," *Jurnal Pendidikan IPA Veteran*, vol. 2, 2018.

[4] W. Van Joolingen, "Cognitive tools for discovery learning," 1998. [Online]. Available: https://telearn.hal.science/hal-00197349v1

[5] Helmiati, *Model Pembelajaran*. Pekanbaru: Aswaja Pressindo, 2012. [Online]. Available: www.aswajapressindo.co.id

[6] A. G. Balım, "The Effects of Discovery Learning on Students' Success and Inquiry Learning Skills," *Eurasian Journal of Educational Research*, vol. 35, 2009.

[7] M. Kamaluddin and D. B. Widjajanti, "The Impact of Discovery Learning on Students' Mathematics Learning Outcomes," *J Phys Conf Ser*, vol. 1320, no. 1, Nov. 2019, doi: 10.1088/1742-6596/1320/1/012038.

[8] O. Khumairah and M. Chatri, "Comparison between the Application of Science Technology Society Model and Discovery Learning Model on the Student Knowledge Competence in Class XI of SMAN 12 Padang," *International Journal of Progressive Sciences and Technologies*, 2020.

[9] Sufairoh, "Pendekatan Saintifik & Model Pembelajaran K-13," *Jurnal Pendidikan Profesional*, vol. 5 No. 3, 2016.

[10] Rosdiana, D. T. Boleng, and Susilo, "Pengaruh Penggunaan Model Discovery Learning Terhadap Efektivitas dan Hasil Belajar Siswa," *Jurnal Pendidikan*, vol. 2, no. 8, pp. 1060–1064, 2017.

[11] H. M. Musfiqon and Nurdyansyah, *Pendekatan Pembelajaran Saintifik. Nizamia Learning Center*. Sidoarjo: Nizamia Learning Center, 2015.

[12] M. Hosnan, *Pendekatan saintifik dan kontekstual dalam pembelajaran abad 21: Kunci sukses implementasi kurikulum 2013*. Bogor: Ghalia Indonesia, 2014.

[13] I. Aldalur and A. Perez, "Gamification and discovery learning: Motivating and involving students in the learning process," *Heliyon*, vol. 9, no. 1, Jan. 2023, doi: 10.1016/j.heliyon.2023.e13135.

[14] G. R. Aufa and T. Taufik, "Penerapan Pendekatan Saintifik pada Pembelajaran Tematik Terpadu di Kelas II Sekolah Dasar (Studi Literatur)," *Journal of Basic Education*, vol. 3, no. 1, 2020.

[15] R. Novio and S. Mariya, "Pendekatan Saintifik Dengan Sintak Model Pembelajaran Berbasis Penemuan (Discovery Learning) Pada Pembelajaran Geografi," *Jurna Geografi*, vol. 6, no. 1, pp. 100–109, 2017.

[16] Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, dan R & D.* Bandung: CV. Alfabeta, 2015.

[17] R. S. Widyastuti, "Pengembangan Skala Likert Untuk Mengukur Sikap Terhadap Penerapan Penilaian Autentik Siswa Sekolah Menengah Pertama," *Journal Jendela ASWAJA*, vol. 3 No. 2, 2022.

[18] Kementrian Pendidikan Kebudayaan, "Permendikbud Nomor 81a Tahun 2013 Tentang Implementasi Kurikulum," Jakarta. Indonesia, 2013.

[19] R. T. Nurpratiwi, S. Sriwanto, and E. Sarjanti, "Peningkatan Aktivitas dan Prestasi Belajar Siswa Melalui Metode Picture and Picture Dengan Media Audio Visual Pada Mata Pelajaran Geografi di Kelas XI IPS 2 SMA Negeri 1 Bantarkawung," *Geo Edukasi*, vol. 4, no. 2, 2015.

[20] M. F. A. Untari, "Implementasi Pendekatan Saintifik (Scientific Approach) dalam Pembelajaran di Sekolah Dasar," *Seminar Nasional Implementasi Pembelajaran Tematik Dalam Mengoptimalisasi Kurikulum* , 2013.

[21] M. T. S. Wondo, M. F. Mei, and S. B. Seto, "Penggunaan Media Geogebra dalam Pembelajaran Geometri Ruang untuk Meningkatkan Minat dan Hasil Belajar Mahasiswa," *Jurnal Pendidikan Matematika*, vol. 11, no. 2, p. 163, Jul. 2020, doi: 10.36709/jpm.v11i2.12049.

[22] H. Lumbantobing, "The Effect of Interactive Computer Program on Student Accomplishment in Teaching Trigonometry," *International Journal of Science: Basic and Applied Research*, vol. 42, no. 3, pp. 38–48, 2018.

[23] H. Lumbantobing, "Improving Students' Outcome Using Geogebra Interactive Media in Learning Derivatives," *Journal of Honai Math*, vol. 3, no. 1, pp. 101–110, May 2020, doi: 10.30862/jhm.v3i1.115.

[24] C. R. Napitupulu *et al.*, "Comparison of Student Achievement in Teaching Analytic Geometry of Planes and Space Using GeoGebra and Power Point Media at STKIP Abdi Wacana in Semester VI of the Academic Year 2021/2022 in Wamena," *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, vol. 68, 2023.