A Guided Discovery Learning Model to Improve Conceptual Understanding in Learning Physic

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ABSTRACT

Physics, a fundamental branch of science, significantly contributes to a wide range of inventions starting to revolutionize contemporary life and has helped to describe many daily events in detail. Physics is vital for understanding the complexity of current technology and is crucial for the technical advancement of a nation. However, despite its importance, physics is the least popular science subject among students. Students appear to view physics as conceptually tricky and abstract. Utilizing a learning model to improve physics students' conceptual comprehension is possible. The guided exploration approach is a tool for teaching concepts under the supervision of a teacher. This strategy encourages students to participate actively in the development of knowledge. Aim of the study is to explore usage of the guided discovery learning model to promote conceptual comprehension among engineering science students and determine the perceptions of engineering science students regarding guided discovery learning in physics. Purposive sampling was used to choose participants for a pre-and post-testing design involving a single group. Polytechnic Sultan Idris Shah chose fifty students in the first semester of engineering science. Questionnaire and 30 multiple choice questions used to collect data. Guided Discovery learning approach proven can foster an effective learning environment and enhance students' conceptual knowledge of physics. Furthermore, the findings discovered that students responded positively to applying the guided discovery learning paradigm in physics education. The outcomes of this study provide important information regarding using this model to enhance conceptual understanding among study and overcome obstacles in physics education.

Keywords: Physic, Perception, Discovery Learning, Learning Model, Conceptual

INTRODUCTION

Physics is the cornerstone of science education, and students must comprehend the concepts and use the scientific method to defend the physical concepts based on the theory. Physics learning is arranged so students can use the concepts learned to solve physics-related problems instead of simply memorizing them. Physics principles serve a variety of applications, including the improvement of reasoning and analytical thinking skills. Enhancing physics principles and concepts and having the capacity to create self-confidence and knowledge is a prerequisite for advancing one's education and knowledge of science and technology. In light of the reasons mentioned above, conceptual comprehension is essential for students as a prerequisite for pursuing further education and as a prerequisite for applying to daily life or solving daily difficulties (Munawaroh et al., 2021). Prior studies indicate that conceptual comprehension is essential to physics (Gunawan et al., 2021). A challenging issue in this field is that students know the concept but need help comprehending it.

They considered physical notions irrelevant to their daily lives. When learning approaches that pay little regard to students' existing knowledge are used, conceptual understanding issues arise among pupils. Some authors have also observed that students cannot progress in their physical learning, causing teachers to frequently be dissatisfied with their students' academic performance (Gunawan et al., 2021). According to (Nisrina et al., 2017), conceptual understanding among students learning physics remained problematic; therefore, a new learning technique or model is required to assist students in learning physics. Utilizing effective strategies, having access to the appropriate resources, and possessing the requisite abilities are crucial to the learning process. Students can collaborate to construct curriculum-aligned educational experiences, which can foster the development of effective learning (Munawaroh et al., 2021).Importantly, these earlier studies prove that learning is more effective when the specified learning activities involve applying the information to problem-solving. Effective learning requires instructors to know how to select the learning style that will have a beneficial impact on student learning. Academic performance represents students' completion of the learning process (Dimkpa, 2015).Teachers must be able to employ atypical learning models as instructional tools in a variety of ways to assist students in learning. When applied in education, the usage of learning models has a significant influence, primarily because applying the Appropriate learning framework has a substantial influence on student achievement beyond simply creating an attractive learning environment (Ofoghi et al., 2016).

The new generation's interests are incompatible with educators' objectives, making it more challenging to teach abstract concepts in the classroom. In addition, students appear to absorb scientific concepts through rote memorization or other tactics, and they need help comprehending how these concepts are applied. Physics is an essential component of STEM, yet students' challenges with physics learning harm STEM teaching and learning(Bunyamin et al., 2020). Our educators provide several teaching methodologies consistent with global education, but students need help with physics concepts even at the start of a topic. Teachers or educators are tasked with implementing effective and participatory teaching models or approaches following global advancements in science education. However, students encounter difficulties at the beginning of physics topics. Instructional tactics are necessary to enhance students' comprehension and enthusiasm for physics. Educators must place their primary focus on the selection and preparation of instructional materials in order to manage the learning process creatively. Students can actively learn to solve problems with the help of an instructor using this strategy. Typically, students are separated into groups to locate and discuss relevant information. A model is a teaching tool that can be utilised as a lesson action plan to enhance learning results. According to (Fatihatul Ulumi & Rinanto, 2015), the guided learning model is a suitable strategy for physics education because it facilitates learning. The concept of guided discovery learning represents one of the potential approaches to these problems. Through guided exploration classes, teachers instruct students on how to construct their own knowledge. This technique positions teachers as facilitators who help students gain conceptual understanding. This learning style teaches students to search for ideas, develop critical thinking abilities, and solve issues (Fatihatul Ulumi & Rinanto, 2015). Moreover, because this model is founded on a constructivist perspective, this method enables students to construct and deepen their understanding more efficiently.

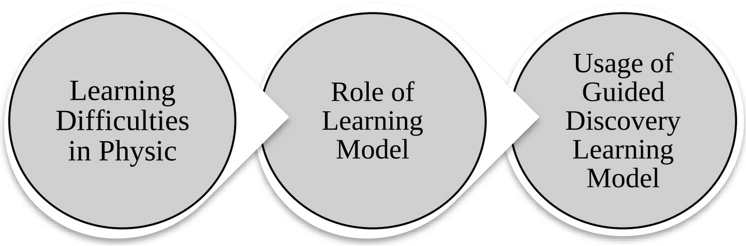
Guided discovery learning assists students in developing and multiplying readiness and independently acquiring knowledge so that it is retained, grows, and progresses in accordance with their abilities. Despite the advantages mentioned above, this model has several disadvantages. It is time-consuming and requires more time to collect knowledge than standard teaching methods. As a result of its advantages and disadvantages, students' impressions of this paradigm differ. Perception is the view of an item, action, or connection received through the research process. It gives response relevance in resuming information and forecasting a message vital to be aware, enthusiasm, intention, and remembrance. Perception is often outlined as a part of the entire action process that permits us to accommodate our course of action to our lived reality. (Karuru et al., 2021). Accordingly, numerous studies have been conducted on the perception of discovery learning (Sakunti, 2018; Tampubolon, 2018), which has increased the relevance of performing a study on the perceptions of discovery learning in physics among polytechnic engineering science students.

Therefore, this study aims to investigate how engineering science students at Polytechnic Sultan Idris Shah use the guided discovery learning model to enhance their conceptual knowledge of physics as they are learning it and how they perceive it.

LITERATURE REVIEW

A literature evaluation began with learning problems in physics and the importance of the learning model in science education after the introduction of the Guided Discovery Learning Model. Figure 1 is a literature review summary.

Figure 1: Overview of Literature Review



A literature evaluation began with learning problems in physics and the importance of the learning model in science education after the introduction of the Guided Discovery Learning Model. Figure 1 is a literature review summary. The reality of the field, particularly in physics education, necessitates more problem-based and event-oriented instructional strategies to ensure that students' physics knowledge is firmly ingrained in their minds and does not confuse the studied topic (Kawuri et al., 2019). According to past studies, the fundamental reason for physics learning challenges is the inability of students to apply their mathematical knowledge to solve physics problems (Liu, 2019). Therefore, serious consideration must be given to the adequacy of teaching instruments in order to advance knowledge (Edalati, 2016). Educators can employ various strategies to raise students' enthusiasm for learning physics and enhance their ability to apply mathematical knowledge in physics. Moreover, efficient teaching tools will aid students in preventing the learning obstacles they encounter and boosting their academic performance. Consequently, guided discovery learning models are regarded as the most effective instructional tools for teaching students to comprehend abstract physical concepts, notwithstanding the improvement of problem-solving and critical-thinking skills (Ariyanto et al., 2020).

Guided discovery learning also emphasizes inquiry-based actual learning activities. This strategy will assist students in developing their knowledge and skills and using appropriate scaffolding for learning tasks. If students are given authentic projects, they will have more possibilities to use their interpretations to complete their assignments. In addition, it requires students to engage in higher-order thinking skills and challenging assignments that they must complete within a given time range. The design of discovery learning should embrace authentic learning modalities since they facilitate the comprehension of complicated concepts and incorporate theories and learning to enrich the process (Baskaran, V. L., & Abdullah, N. (2022). This type of learning is an active learning style since students will be active participants in asking questions and sharing information they find, as opposed to passively absorbing the material offered.

Consequently, the researcher intends to investigate how engineering science students at Polytechnic Sultan Idris Shah use the guided discovery learning model to improve their conceptual understanding of physics as they are learning it and how they perceive it.

Problem Statement

Students' lack of interest in physics has emerged as a concern in physics education(Wafry Khairul Ziad et al., 2021). This scenario makes it difficult for instructors to assess pupils' enthusiasm to study physics. Students have always regarded physics as one of the most challenging and terrifying disciplines (Kasmiana et al., 2020).Various research projects are currently being undertaken to investigate the elements that influence the interest and performance of students in physics. The complexity of physics, which is supposed to be composed entirely of mathematical formulas, is the most influential factor, followed by teachers' teaching methodologies (Reddy & Panacharoensawad, 2017)A lack of mathematical knowledge contributes to disinterest in physics-related topics or subjects. Specifically, under the category of problem-solving, mathematics is a crucial component of physics concerns. In addition, students' perception of physics as a complex topic causes them to despise it and view it as unimportant(Liu, 2019).Thus, educators must consequently construct inquiry-based instruction that promotes conceptual understanding and critical thinking throughout the learning process. The perception is that inquiry-based science education, which includes assisting students in exploring scientific phenomena, is essential for making science classes attractive and engaging (Nik Yusuf et al., 2017). The guided discovery learning approach can increase the capacity to think critically and get a deeper understanding of physics subjects because it is known as a method of instruction that allows pupils to conduct their knowledge searches. This technique eventually fosters personal development because it enables students to achieve their academic goals with or without the support of educators (Onikarini, 2019). It also demonstrated decisively that the discovery model enhances student learning results; for instance, guided learning enhances student learning outcomes (Setiadi & Irhasyuarna, 2017). Discovery learning enhances students' creative thinking abilities in subject-matter learning. As a result of the preceding definitions, the researcher would like to know what students think of this physics-learning technique. The researcher is eager to perform this study to learn more about and investigate how to use the guided discovery learning model to improve engineering science students' conceptual grasp and determine the students' perceptions of this model when learning physics.

OBJECTIVES

The following are the study's objectives:

i. To explore the use of the guided discovery learning model to improve conceptual understanding of engineering science students

ii. To examine the perspectives of engineering science students about guided discovery learning in physics

METHODOLOGY

In this study, one group pretest and posttest design were adopted. Purposive sampling was used in this study with 50 students from the first semester of the Engineering Science course at Polytechnic Sultan Idris. The test comprises 30 multiple-choice questions distributed out. The test instrument was divided into six sections based on Bloom's taxonomy: recall, understand, apply, analyze, evaluate, and create. The reliability coefficient of 0.85 indicates the instrument's consistency and appropriateness. Hake's criteria are used to calculate and evaluate average N-gain scores. This study's N-Gain Score Interpretation is as follows: $g>0.7$ is High $0.3<g\leq 0.7$ is Medium, and $g\leq 0.3$ is low. This study also

investigates how students view guided discovery learning in physics. This study's questionnaire was created using Google Forms. The researcher instructed the students on how to complete the questionnaire and its objective. The questionnaire includes stimulation, problem statement, data collection, data processing, validation, and generalization. A scale from 1 to 5 was utilized, with 1 representing strong disagreement and 5 indicating strong agreement. In addition, the interval score was utilized to analyze the researched questionnaire category

Table 1: Score Interval

Very good/Very Positive	$4.5 \le n \le 5$
Good/Positive	$3.5 \le n \le 4.4$
Enough/ Fair	$2.5 \le n \le 3.4$
Bad/ Negative	$1.5 \le n \le 2.4$
Very Bad/ Very Negative	$0 \le n \le 1.4$

RESULTS AND DISCUSSION

The study's conclusions are based on guided discovery learning to improve students' conceptual understanding of physics topics and their perceptions of the model. Figure 2 shows the findings.

Figure 2: Overview of the findings

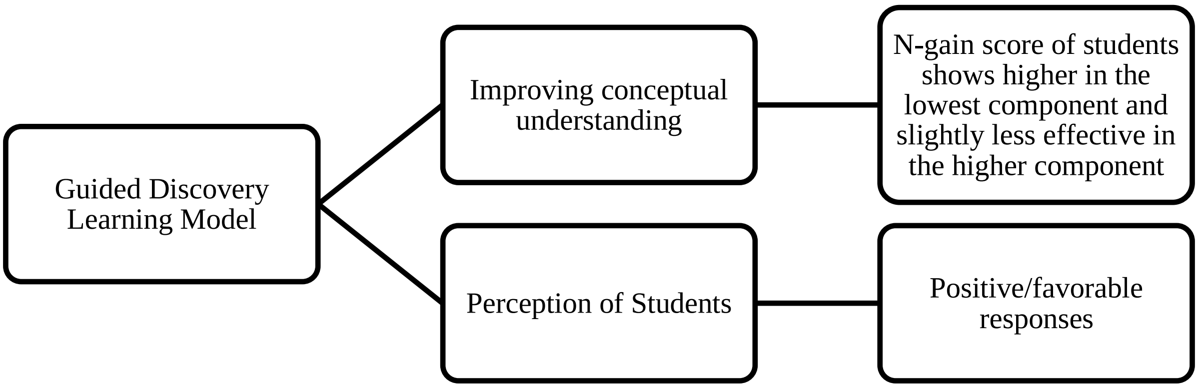


Table 2: Average score

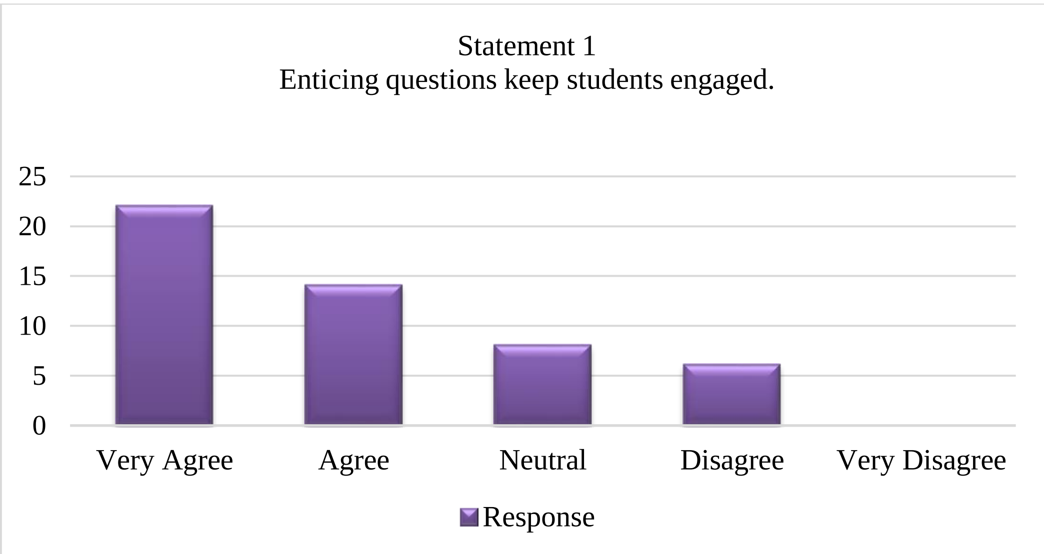
AVERAGE SCORE						
	C1	**C2**	**C3**	**C4**	**C5**	**C6**
Pre-Test	50.80	45.60	48.00	31.20	23.56	24.80
Post-Test	87.20	78.80	72.40	56.40	51.20	47.60
N-Gain	0.74	0.61	0.47	0.37	0.36	0.30
N-Gain (%)	73.98	61.03	46.92	36.63	36.16	30.32

Table 4 displays N-gain scores for each facet of conceptual knowledge. The N-gain value of C1 is extremely criterion-dependent, which indicates that the growth in C1 is substantial due to the students' guided discovery learning experiences. This technique investigates concepts using brief, primary language and provides an explanation that aids students in readily recalling their definitions.

In remembering, there are no problematic concerns or problems to resolve. Students must retain and recall the terms, definitions, and formulas learned for the concepts. According to (Sagala & Andriani, 2019), asking students to recollect specific knowledge will boost their learning processes. Each student must also meet a rigorous standard in C2. This outcome is the result of their learning utilizing the guided discovery learning approach. This type of learning often loaded with learning exercises that can help students overcome their misunderstandings. Utilizing elements such as small discussion groups include elaborating concepts and examples to enhance students' conceptual knowledge, hence facilitating their adequate comprehension of the issue. Students must interpret instructional communications, including spoken, written, and visual data. The N-gain scores were in medium on the C3 and C4 scales, respectively. The applying and analysing component challenges students to deconstruct previously acquired knowledge into its parts and determine the relationships between them. The N-gain for C5 and C6 is relatively low because analysing and generating problems requires students to employ higher-order thinking abilities and what they have learned to solve them. The average score on the pre-test and post-test, classified as "medium," indicates that the items in these two categories are the most challenging. According to (Tai et al., 2018) and (Koretsky et al., 2018), this category requires students to apply what they have learned to address specific situations. The post-test results indicate that students' conceptual comprehension is also improving, that congruent with (Hendrik & Minarni, 2017) and (Gunawan et al., 2021), who found that the discovery learning paradigm enhances students' conceptual mastery. Consequently, the study's findings demonstrate that the discovery learning method can assist students in acquiring a more profound conceptual knowledge of physics. According to the above review, students could answer questions in the lowest category compared to higher categories, such as evaluating and developing. The application of guided discovery learning improved students' conceptual knowledge and boosted their enthusiasm to learn. This study's findings match those of (Gunawan et al., 2021), who discovered that students are willing to learn when effective and participatory teaching methods or models are available. The students' perspectives on the Guided Discovery model were also utilized in clearly defining the research project's goals and objectives.

A) Stimulation

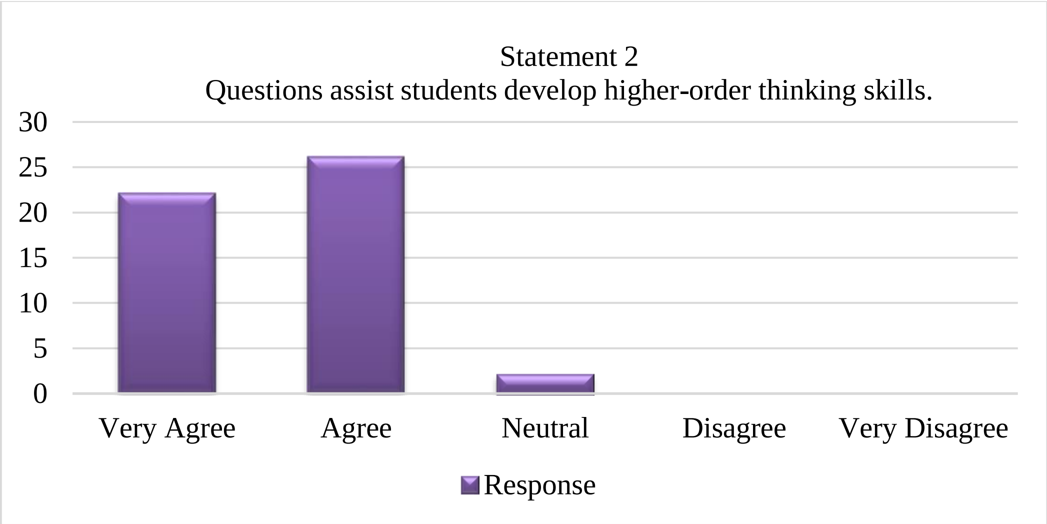
Diagram 1: Statement 1



Out of 50 students, 22 selected "Very Agree", and 14 selected "Agree", as shown in Diagram 1. Eight students selected "neutral," six selected "disagree," and none selected "strongly disagree."

The average score for Syntax 1 was 4.04, indicating that students responded positively. They agreed that engaging students with appealing questions during class sessions would increase their desire to study physics.

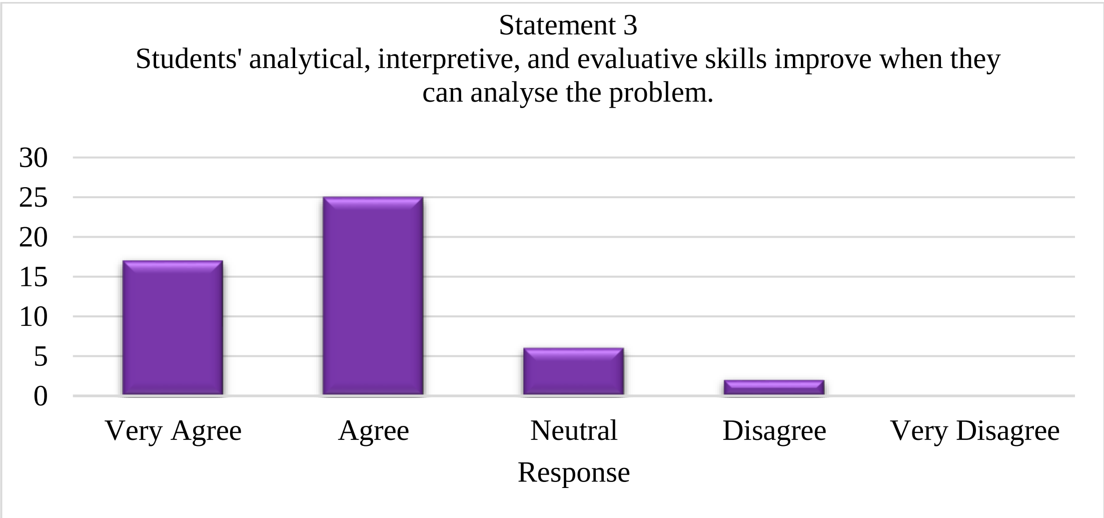
Diagram 2: Statement 2



According to Diagram 2, 22 students selected "Strongly Agree," 26 selected "Agree," 2 selected "Neutral," and none selected "Disagree or Strongly Disagree", which indicates that students agree that asking questions helps them develop higher-order thinking skills.

B) Problem Statement

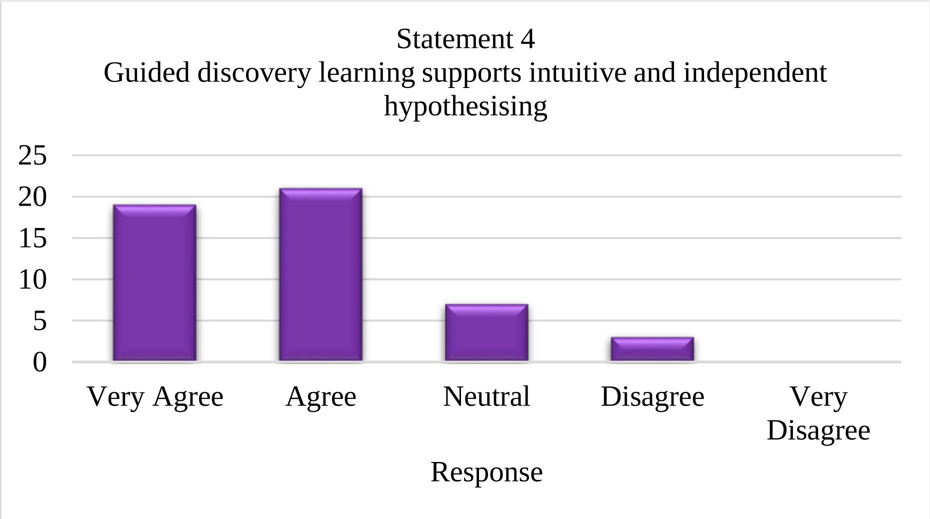
Diagram 3: Statement 3



In Diagram 3, 17 out of 50 students selected "Strongly Agree" in Diagram 3. In the meantime, 25 students selected ", six students selected ", two students selected ", and 0 students selected "strongly disagree." The average score for syntax 3 was 4.14, suggesting that students agreed that answering the problem enhanced their analytical, interpretation, assessment, and deduction abilities.

According to most responders, allowing students to solve the problem improves their grasp of the concepts, analysis, evaluation, and explanation.

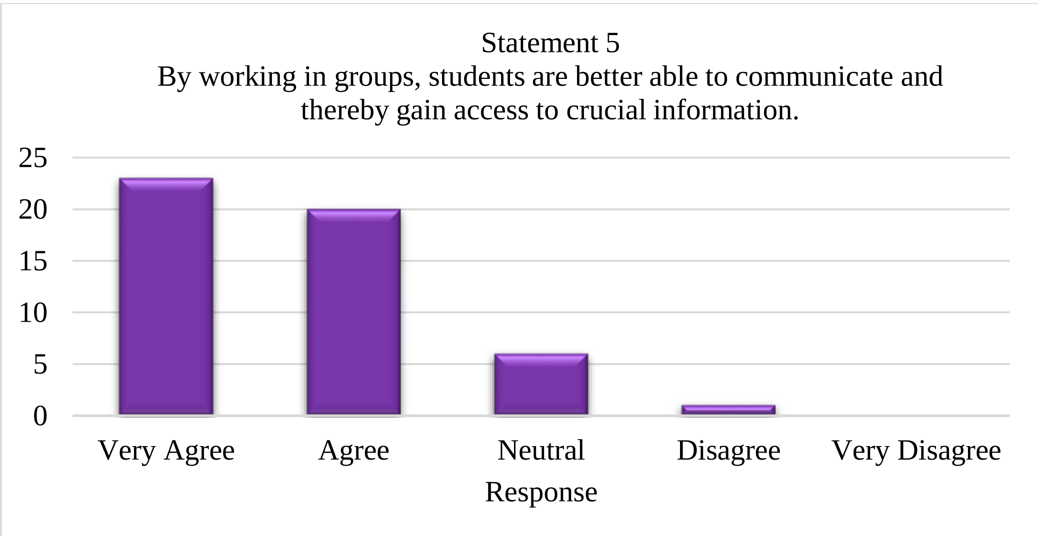
Diagram 4: Statement 4



19 of 50 students selected to be highly agreeable, as depicted in Diagram 4. 21 students selected "agree," 7 selected "neutral," 3 selected "disagree," and none selected "strongly disagree." After analyzing the data, the average score for syntax 4 was 4.12, suggesting that students responded positively or favorably. According to the kids, the discovery learning paradigm enables them to think critically and independently.

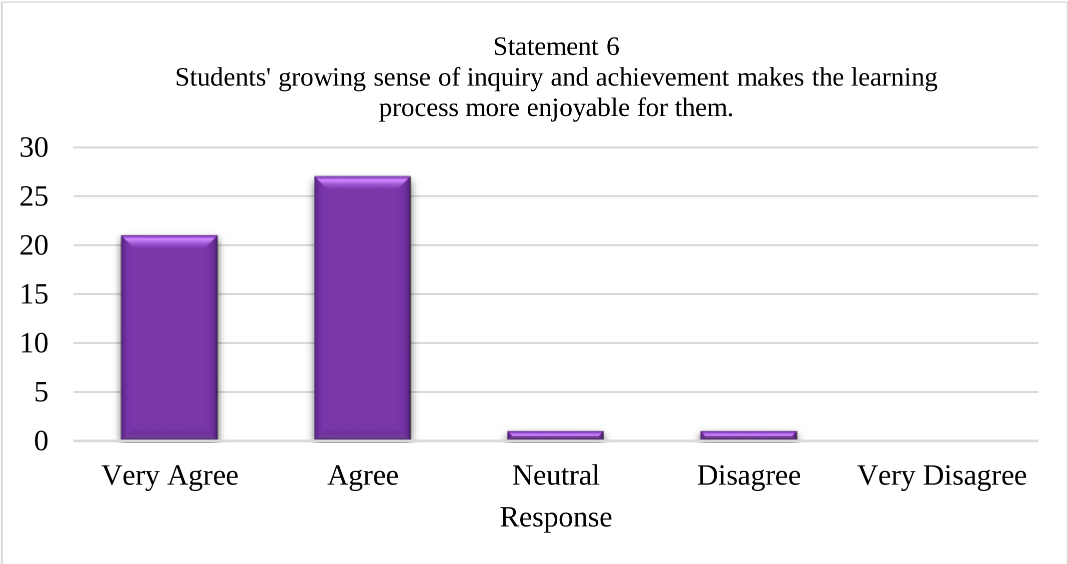
C) Data collection

Diagram 5: Statement 5



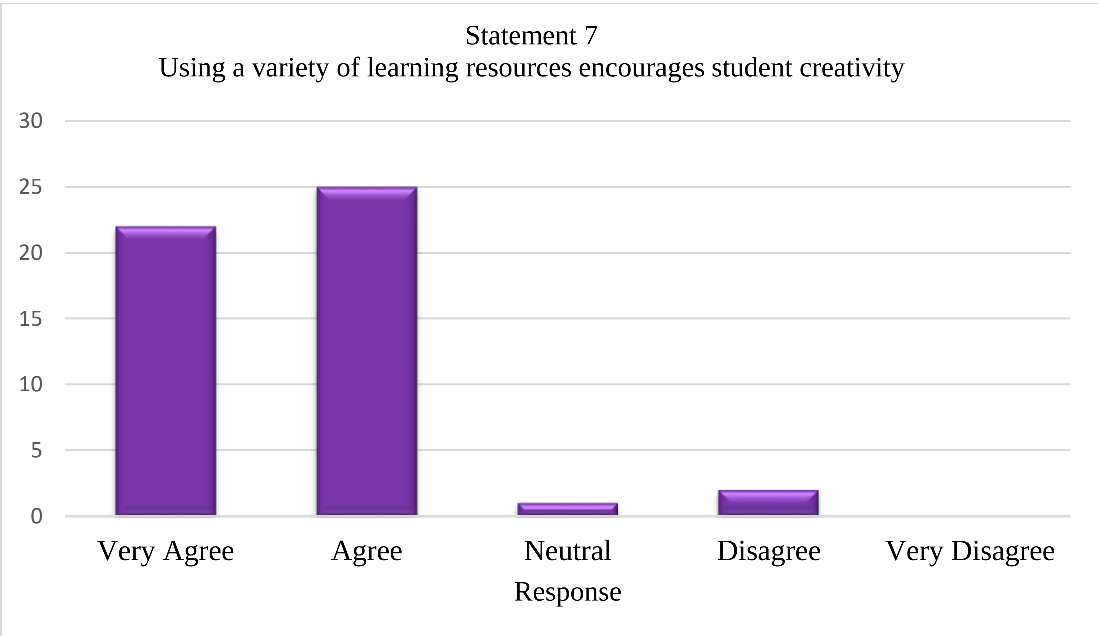
Twenty-three students selected "Strongly Agree" in Diagram 5, while 20 selected "Agree," 6 selected "Neutral," and one selected "Disagree." The average grade for Syntax 5 was 4.3, suggesting that students responded positively to the material. Classmates concurred that grouping students allows them to collect vital information, which facilitates the development of their communication and teamwork abilities.

Diagram 6: Statement 6



21 students out of 50 selected "Strongly Agree" as their response in Diagram 6. 27 students chose "agree," 1 student chose "neutral," 1 student chose "disagree," and none chose "strongly disagree." The average score on the syntax six examinations was 4.36. This score shows that students responded positively to this model.

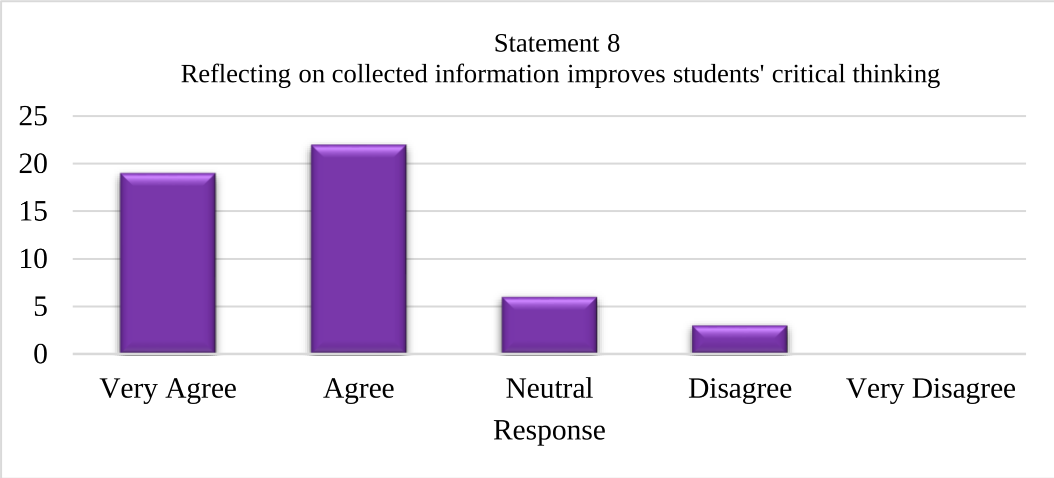
Diagram 7: Statement 7



According to Diagram 7, 22 students selected "Very Agree", and 25 selected "Agree." One student has selected "neutral," two students have selected "disagree," and none have selected "strongly disagree." 4.34 was the average score for this syntax 4, which indicates that students felt that having a choice of learning materials promotes and motivates them to be more engaged and creative in their studies.

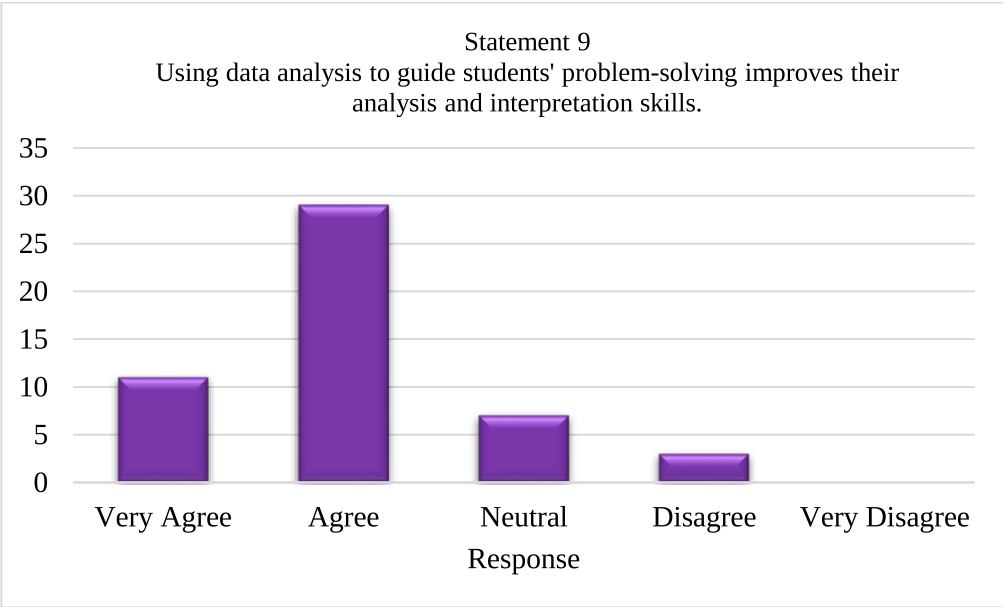
D) Data Processing

Diagram 8: Statement 8



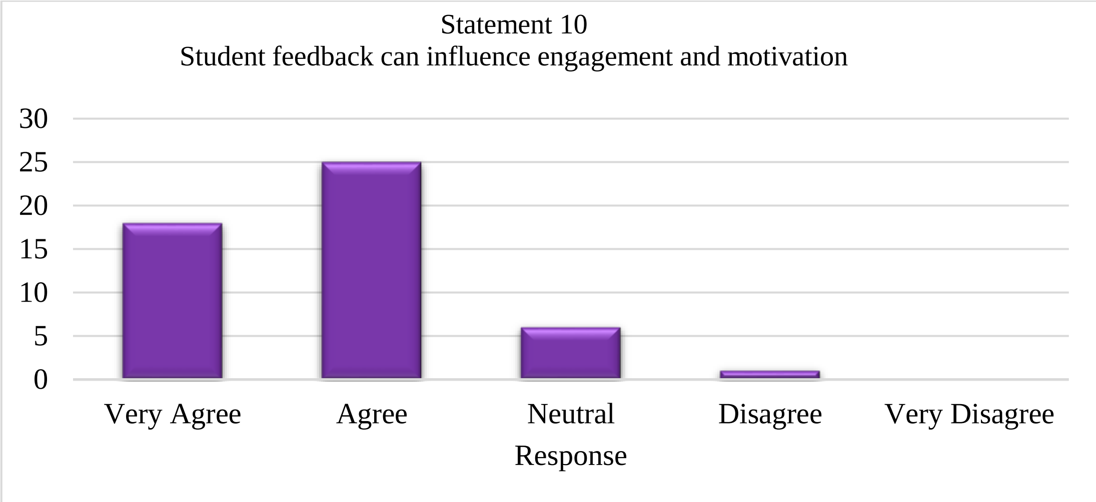
Nineteen students selected "Very Agree", 22 selected "Agree", and six selected "Neutral." None of the three students who selected "Disagree" also chose "Strongly Disagree." The average score for Syntax 8 was 4.14, reflecting student satisfaction. They concurred that allowing students to analyse information improves their critical thinking skills.

Diagram 9: Statement 9



According to Diagram 9, eleven students out of fifty selected "Strongly Agree." Nine students selected "agree," 7 selected "neutral," 3 selected "disagree," and none selected "strongly disagree." The average score for Syntax 9 was 3.96, indicating that students responded positively. Students agreed that guiding them to solve problems based on data analysis outcomes enhances their data analysis and interpretation abilities.

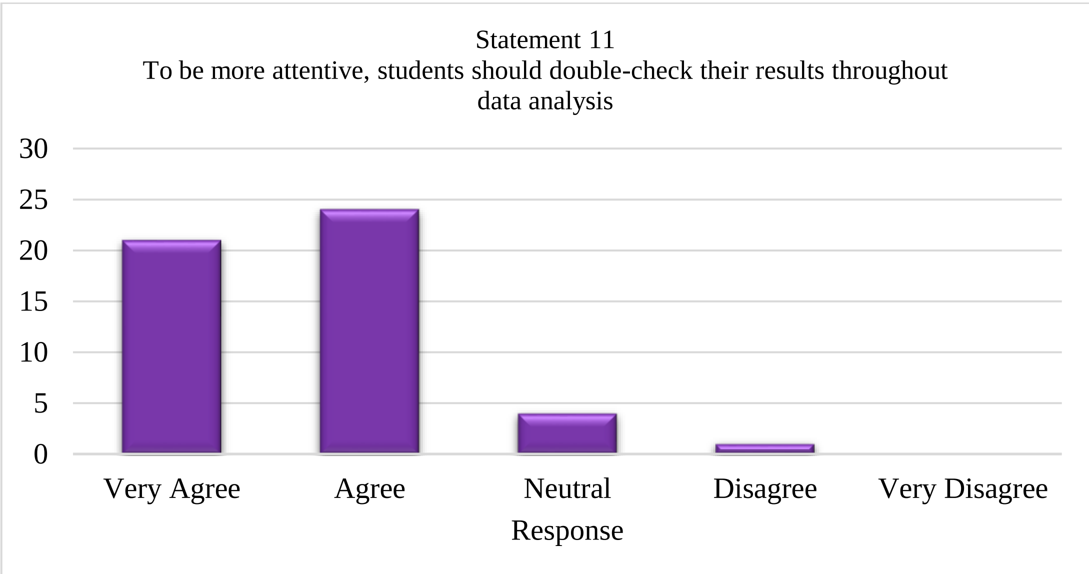
Diagram 10: Statement 10



Eighteen students selected "Strongly Agree" in diagram 10, 25 selected "Agree," 6 selected "Neutral," 1 selected "Disagree," and none selected "Strongly Disagree." The mean score was 4.2 indicates positive responses and comments to students that enhance their motivation and learning process participation.

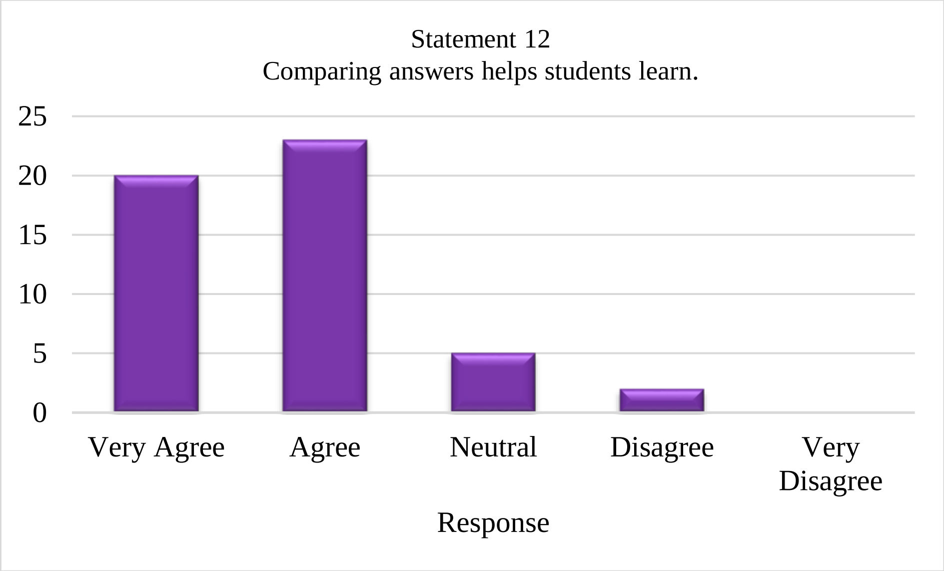
E) Verification

Diagram 11: Statement 11



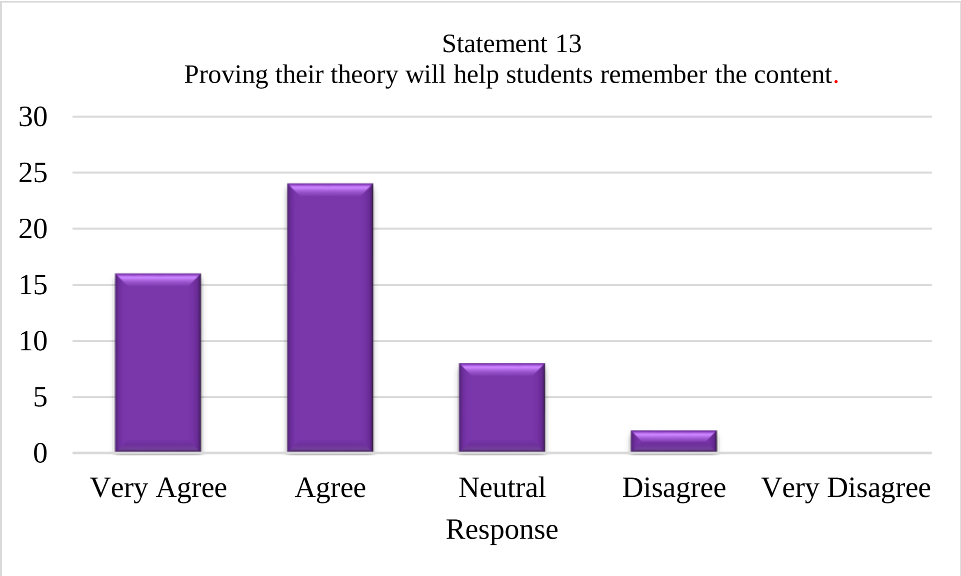
Twenty-one students selected "Very Agree," while twenty-four selected "Agree." Four students chose "Neutral," and one chose "Disagree," The average Syntax 11 grade was 4.3, indicating that students agreed that cross-checking their solution or answer after analysis will let them concentrate more on problem-solving.

Diagram 12: Statement 12



Twenty-one students selected "Very Agree," while twenty-four selected "Agree." Four students chose "Neutral," one student chose "Disagree," and none chose "Strongly Disagree." 4.04 was the mean score, demonstrating that students believe comparing their responses to those of other groups facilitates the incorporation of new information with prior knowledge.

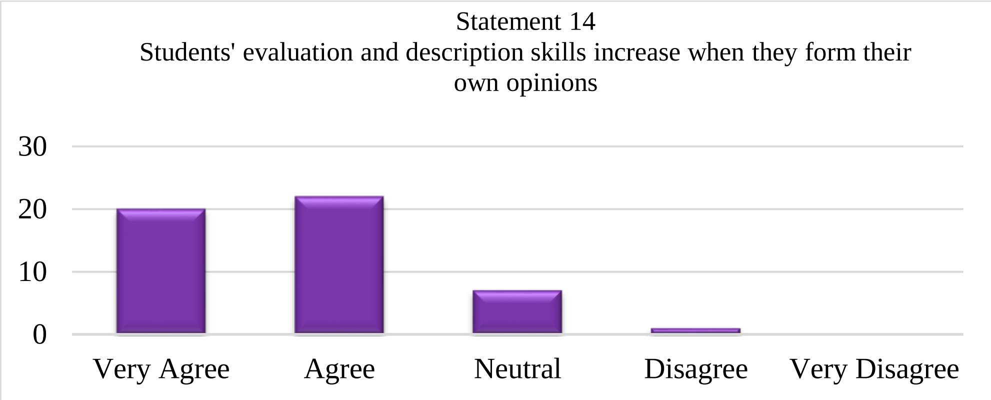
Diagram 13: Statement 13



Sixteen students selected "Very Agree," 24 students selected "Agree," 8 students selected "Neutral," 2 students selected "Disagree," and none selected "Strongly Disagree." Students are more likely to recall a topic if they can substantiate their hypothesis. The mean score was 3.72, showing a good response from students.

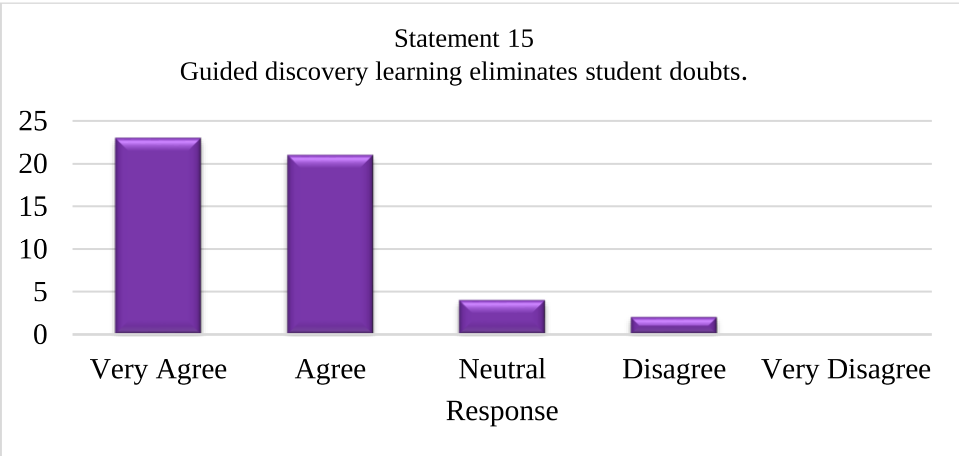
F) Generalization

Diagram 14: Statement 14



Twenty students selected "Strongly Agree," 22 students selected "Agree," 7 students selected "Neutral," 1 student selected "Disagree," and none selected "Strongly Disagree." The average score for Syntax 14 was 3.86, indicating that students responded favorably.

Diagram 15: Statement 15



According to Diagram 15, 23 out of 50 students selected "Strongly Agree." Twenty-one students selected "agree". Four students chose "Neutral." Two students selected "disagree", but none selected "strongly disagree." The average score for syntax 15 was 4.18, suggesting that students viewed it favorably. Most students said that discovery learning helped them clear up their questions regarding the topic.

The guided discovery model attempts to increase students' active engagement in acquiring their information or knowledge to achieve learning objectives. This model incorporates learning activities and resources to maintain student engagement in the learning environment, with the teacher or educator as a facilitator. It has been shown that this learning enhances pupils' critical thinking skills and desire to seek solutions or answers to challenges(Yuliani & Suragih, 2015). In addition, the guided discovery model's learning approach strives to increase students' abilities in various areas, including discovery, problem-solving, and autonomous and creative thinking. According to the results, most students selected "Very Agree" or "Agree" on the questionnaire. In contrast, no one selected "Strongly Disagree." This demonstrates that the guided discovery approach is an excellent instructional strategy for promoting student participation and motivation, as well as supporting students in attaining an in-depth, clear grasp of issues. The six steps of guided discovery learning are as follows: stimulation, problem description, data collection, data processing, validation, and generalization (Hanafi, 2016).The questionnaire was built using discovery learning syntax.

The first syntax, stimulation, occurs when the interest of the students in the material that they will study in class can be motivated by the teacher through the use of engaging questions or audio-visual components. The stimulation scores of 4.04 and 4.4 suggest that the students responded favorably or positively. Students concur that intriguing questions motivate students to learn. The guided discovery model is a cognitive learning approach that requires the instructor to be more creative in building an atmosphere in which students can actively explore their understanding to address complex and abstract challenges (Kasmiana et al., 2020). The means of the second syntax, "Problem Statement," are 4.14 and 4.12, both of which indicate good replies. Students concurred that allowing them to define the problem enhances their analytical, interpretation, assessment, and deduction skills. Guided discovery learning directs students to discover topics that encourage them to think and analyze themselves during the learning process to discover concepts based on the offered content or knowledge (Kasmiana et al., 2020)**.** This model is suitable for physics education to enhance conceptual comprehension and student motivation. The third syntax, data collecting, expects students to collect information from numerous sources to address the problem (Hanafi, 2016). Therefore, their communication and teamwork abilities will improve. 4.12, 4.34, and 4.36 are affirmative responses by the third syntax, "Data Collection," which indicates that students feel that learning can help them develop their communication and teamwork abilities while also making the learning environment more engaging. As for the fourth step of syntax, data processing, pupils must be able to analyze the obtained data in order to comprehend the learnt notion. Students' analytical and interpretative skills may be enhanced through the discovery learning approach, which heavily emphasizes students' engagement in knowledge construction. The means for the fourth syntax that displays favorable replies are 4.14, 3.96, and 4.2.

The mean for the fourth syntactic, data processing, are 4.14, 3.96, and 4.2, indicating that it received a favorable response from the students, who agreed that this model boosts their analytic and interpretive learning skills. The fifth syntax is verification, in which students must cross-check their solution or results with other groups of peers, teachers, or any relevant source of information. The mean scores for this syntax are 4.30, 4.04, and 3.72, indicating that the guided discovery learning paradigm improves problem-solving diligence (Hanafi, 2016). In addition, students frequently have the chance to share and exchange opinions in class as part of learning activities. Students can listen to other students' explanations of topics or questions to develop a better understanding which has proven to be an effective method for fostering equity in the classroom, as all students can voice their opinions on the solutions(Arya Wulandari et al., 2018). Through sharing, individuals can assess the perspectives of others and establish or strengthen their knowledge in response to what they have heard. Finally, this assignment can be used to measure pupils' conceptual understanding. Students respond favorably to the sixth syntax of generalization, which consists of the numbers 3.86 and 4.18. Overall, student perceptions of the discovery learning paradigm for studying physics are good, as demonstrated by the high mean score for each syntax. This conclusion is consistent with those of (Nurhidayah, 2011) and (Tampubolon, 2018), who found that university students refer to learning using the discovery learning technique because they believe it increases their participation and seriousness in the learning process.

CONCLUSION

According to the findings, students' conceptual competence has moderately increased, which highlights how adopting tools from the discovery learning paradigm can assist students in developing a more profound knowledge of concepts across all subject areas. Students have a better chance of understanding how the information being taught is organised when they use the discovery learning strategy (O'Dwyer et al., 2015). Students who are utilising the discovery learning strategy need to consistently engage in topic inquiry that is logical, methodical, and essential in order for them to be able to come to their conclusions (Putri, 2020). In addition, students must actively conceptualize ideas when using the discovery method of education (Wafa & Jatmiko, 2022) . Therefore, it is reasonable to conclude that the discovery learning strategy enables students of polytechnic institutions to understand physics concepts better. The researcher also concludes that the findings of all five indicators regarding students' perceptions and good/positive responses are consistent. According to the results of this study, engineering science students attending Polytechnic Sultan Idris Shah had a positive attitude toward discovery learning

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