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A New Pattern to Improving Student Physics Learning Outcomes

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Abstract: The low student learning outcomes in Physics can be observed by the decreasing average student learning outcomes in the last 3 years at SMA 1 Suger. Lack of precise strategy selection is a major factor in influencing student learning outcomes in Physics. In addition to learning strategy factors, students' initial abilities can be considered by teachers in choosing learning strategies to improve student learning outcomes. The purpose of this study was to compare students' learning outcomes in physics between classes using guided inquiry and discovery strategies by considering initial ability as a moderator variable. This type of research is a quasi-experimental, the sampling technique used is random sampling. This research was conducted at SMA 1 Suger, Padang Pariaman Regency. The results of the study show 1) there is a significant difference between the learning outcomes of physics students who learn to use guided inquiry and discovery strategies, 2) there are significant differences in learning outcomes between students with high and low initial abilities, 3) there is no interaction between the use of strategies and abilities early in influencing student learning outcomes.

Keywords: Discovery learning; Inquiry; Learning model; Learning strategies; Prior knowledge

Introduction

Education is an important foundation in building a country. Increasing the quality of education in a country will help improve the quality of Human Resources (HR) in that country (Zakirman et al., 2020). According to the Law of the Republic of Indonesia Number 20 of 2003, education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality intelligence, noble character, and skills needed by himself, society, nation and state (Djihad, 2013).

To improve the intelligence and skills of students, it is necessary to improve the quality of education. Efforts to improve the quality of education can be carried out by several parties including by the government, by the teachers/teachers and the students themselves (Rahayu et al., 2022). In improving the quality of education, the government has made several improvements to the curriculum in the world of education. One of the seriousness and real efforts of the government in improving the quality of education is to make improvements to the 2013 curriculum. Improvements are carried out on learning activities and processes as well as refinement of learning competency assessment instruments (Setiadi, 2016).

The focus of assessment in the 2013 curriculum is student learning success in achieving specified competency standards, including attitudes, skills and knowledge. Achievement of student competence really measurable and empirical, therefore there must be a clear formulation of the criteria for competence. The following are competent criteria that must be achieved by students, including: (1) Students are able to understand the concepts underlying competency standards which must be mastered, (2) Students are able to do work in accordance with competency standards which must be achieved with the correct procedures and good results, (3) Students are able to apply their abilities in everyday life (Kusnandar, 2013).

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Students can be said to be competent after being assessed with instruments that are really competent in a real and relative way permanent/fixed, so that the information provided is truly accurate (Taras, 2010). Achievement of student competence is something that is measurable, operational and students experience personally in the learning process (Winaryati, 2018).

Assessment is an integral part of a lesson. In each learning, assessment serves to measure the extent to which students can achieve the learning objectives that have been set. Rating in learning assist teachers in evaluating effectiveness curriculum, teaching strategies and learning activities that include competencies knowledge, attitudes and skills of students. Assessment is a process or activity that is systematic and continuous for collect information about the process and student learning outcomes in order make decisions based on certain criteria and considerations. Assessment is not only limited to grades, but through the teacher's assessment can celebrate achievements and support students in meeting challenges study (Lederman & Lederman, 2019).

Assessment must not only support sound judgements about learner competence, but also generate meaningful feedback to guide learning. Reconciling the tension between assessment's focus on judgement and decision making and feedback's focus on growth and development represents a critical challenge for students (Watling & Ginsburg, 2019). Learning competency assessment instruments include knowledge competency assessment instruments, attitude competency assessments and performance/skills assessments. For the competence of knowledge and skills can involve teachers directly in the activities of collecting assessment data (Aini, 2013).

Ideally, in compiling assessment tools, it must be adjusted to the strategies used in learning activities. There are many learning strategies that can be applied in every learning activity. Creative teachers can use varied learning strategies for each different type of material. In choosing the learning strategy that will be used, the teacher must pay attention to several important things including the characteristics of the material to be taught, the characteristics of students and adjust the learning strategy to be chosen with the learning objectives. The use of varied strategies and adapted to the objectives, characteristics of students and the characteristics of the material to be taught can improve student learning competencies.

The facts found at SMA 1 Suger show that there are still many percentages of students who have low scores in Physics subjects. These causes include: The choice of strategy is not right because it has not been adjusted to the characteristics of the material, student characteristics and learning objectives. In learning activities the teacher has not optimized the use of the laboratory. Learning concept is teacher centre. In learning activities, the teacher has not linked the learning material with the problems encountered in everyday life.

To overcome the existing problems, learning strategies can be used which in the selection process have considered the characteristics of the material to be taught, student characteristics and learning objectives (Asfani et al., 2016). The use of guided inquiry and discovery strategies can overcome problems in learning activities because in choosing these learning strategies they have paid attention to the problems found in the field as well as the characteristics of the material to be taught, student characteristics and learning objectives to be achieved (Akanmu, 2013).

The guided discovery model is a learning model that involve students to learn actively and independent in an activity to use find a concept or a solution problems with the guidance of the teacher. Bruner suggests that in discovery learning students will play a more active role because students try themselves solve problems and earn certain knowledge really meaningful (Priadi et al., 2021). Role teacher in this guided discovery model is a facilitator in the process learning, namely by helping students to be able to use the concept and skills that have been learned before to get new knowledge by asking questions. Guided model. This discovery requires students use the information obtained to construct understanding themselves so that the understanding of the material is more remain in the memory of students (Destrini et al., 2019).

Discovery learning models on basically make learners have the ability to ask observe, collect information, process information, and draw conclusions (Yerimadesi et al., 2019). Model discovery emphasizes its importance understanding of important structures or ideas towards a science through engagement students are active in learning. When applying the discovery method learning, the teacher acts as mentor by providing opportunity for students to learn actively. Conditions like this can change teaching and learning activities which the material was originally notified to students become learners who find out (Ariyani et al., 2017).

Discovery learning model too provides many opportunities for the students to be directly involved in learning activities, activities like that will more motivation to learn, because it is adjusted to the interests and their own needs. This discovery learning model focus on mental abilities and the physique of the students who will strengthens vigor and concentration they are doing activities learning. Student not only given the theory, but them dealing with a number of facts.

From theory and facts that, they are expected able to formulate a number of discoveries. Thus, students are motivated to demonstrate cognitive abilities in studying physics and students get the maximum benefit of the learning process and outcomes. So, in Discovery learning, material or subject matter is not delivered in final form but students are encouraged to identify what it wants known to proceed with the search own information then organize or shape what they know and understand deeply a final form (Putri et al., 2017; Simamora et al., 2018).

The role of students' initial abilities in guided inquiry and discovery learning strategies is seen in the problem formulation and hypothesis activities. Students with high initial abilities will more easily relate their abilities to the problems being discussed so that they can easily formulate provisional conjectures (hypotheses). In addition, in grouping students, teachers can also consider students' initial abilities so that each group is heterogeneous (Yulianto, 2013).

The use of the discovery learning method, wants to change the conditions of learning that passively become active and creative (Syarif et al., 2020). Changing learning is teacher oriented to student oriented. Changing the expository mode, students only receive information as a whole from the teacher to discovery mode, learners find their own information. In applying the discovery learning method the teacher acts as a mentor by providing opportunities for students to learn actively, the teacher must be able to guide and direct the learning activities of students in accordance with the objectives (Fahmi et al., 2019).

Curiosity in real-world circumstances is most likely explained by a combination of multiple high-level factors (e.g., prior knowledge). while learners' curiosity is best predicted by how close they think they are, their actual learning is predicted by their actual prior knowledge, with a small apparent boost from being curious about the topic. The implication is that the mechanisms that drive learners' curiosity are not identical to those that drive learning outcomes. These results also highlight the important role of metacognition in the processes that guide motivation and learning (Wade & Kidd, 2019).

Prior knowledge of relational structure allows people to quickly make sense of and respond to new experiences. When awareness of such structure is not necessary to support learning, however, it is unclear when and why individuals "spontaneously discover" an underlying relational schema rior work showing that the dynamics of training-specifically, the manner in which sequences of training examples are generated-can influence whether people identify abstract rules or relations when learning concepts (Markant, 2022).

The purpose of this study was to determine the differences in learning competencies between students whose learning uses guided inquiry and discovery strategies, to determine the differences in learning competencies between students with high and low prior knowledge, to determine the interaction between the use of strategies and initial abilities in influencing student physics learning outcomes.

Method

In this study used a research method with a factorial design. In this study, there were also two treatment groups, namely the group with the treatment using guided inquiry and discovery strategies. Prior to treatment, a test was conducted to determine the initial ability of each group. Then students are grouped based on their initial abilities. The data analysis technique used is two-way ANOVA, with prerequisite tests in the form of normality and homogeneity tests. Research design as follows:

Table 1. Factorial 2 x 2

Strategy / Prior Kn	G.I. (A1)	Dscv (A2)
High (B1)	A1B1	A2B2
Low (B2)	A1B2	A2B2

There are five steps in sampling, that's randomly select two classes for which the initial ability test will be conducted. Then conduct a preliminary ability test. Before being given treatment to the two experimental classes, the data must be normally distributed and cognitively homogeneous. Then conduct normality test and homogeneity test on students' initial ability data. The next step is obtain two classes of samples that have been normally distributed and homogeneous. Then test the similarity of two averages using the t-test to see the average similarity of the selected sample class groups.

Result and Discussion

The data obtained from the results of this study are quantitative data. To test the truth of hypothesis, calculations using the two-way Anova equation were used. The summary of the results of data calculations is shown in Table 2.

Table 2. Calculation Results Using Two-Way Anova

Hypothesis	F	F_{tabel}
First	4.254544	
Second	4.883301	4.0
Third	0.883025	

For hypothesis testing, the following conclusions that's are hypothesis 1, from the results of the two-way ANOVA calculations that have been carried out, there is a rejection of Ho, meaning that there is a significant difference in learning competence between students whose learning uses guided inquiry and discovery strategies. Based on the results of the second hypothesis testing that has been carried out, it can be concluded that there are significant differences in learning outcomes between students who have high initial abilities and students who have low initial abilities. Based on the third hypothesis testing that has been done, it can be concluded that there is a rejection of Hi and acceptance of Ho. This means that there is no interaction between the use of learning strategies and students' initial ability to influence learning outcomes.

Both types of learning strategies can improve student learning competence. However, learning activities using the discovery strategy showed a higher average increase in learning competence when compared to classes using the guided inquiry strategy. The high increase in student learning competence using the discovery strategy is because students are accustomed to being trained to think analytically. The use of the discovery learning strategy allows students to be involved in building their own knowledge (William, 2011). The lower average result of the knowledge competency assessment using the guided inquiry strategy is because the use of this strategy takes a long time to change the learning habits of students who usually receive material from the teacher into a pattern of independent learning activities. The guided inquiry learning strategy also does not guarantee that students study diligently and purposefully because the learning gives students freedom in learning.

The characteristics of the material and its compatibility with the learning strategy also influence the students' learning competence in Physics. The Discovery learning strategy will be more suitable and effective for learning materials that involve students in practical activities. The material selected during the research was material that involved students in practicum activities. In other words, the characteristics of the material used match the Discovery strategy. This is one of the causes of the high learning outcomes of students who use the discovery strategy when compared to guided inquiry.

Guided inquiry learning strategies and Discovery can be used in various situations in learning without considering high or low initial abilities. However, teachers must pay attention to the initial abilities or prerequisite materials in an effort to improve students' learning competence in Physics (Voorhees, 2001).

The lower average achievement of student learning competencies using guided inquiry strategies can be caused by students' thinking ability to express the relationship between concepts and students' assumptions that there is a readiness of mind to learn. In addition, in learning using guided inquiry strategies, students with low initial abilities will be quite left behind when compared to students with high initial abilities because learning using this strategy is based on the freedom of students' learning styles. Basically, the use of guided inquiry strategies requires the readiness of students such as having a fairly good initial ability so that it will assist them in participating in learning activities in each phase.

The interaction between learning strategies and students' initial abilities can be described with a graph. If there is an interaction between learning strategies and initial abilities, then one part of the graph will experience an intersection. Referring to the hypothesis that has been tested, it can be stated that there is no interaction between learning strategies and students' initial abilities.

Factor A does not depend on factor B, and the effect of factor B also does not depend on factor A. Each factor (learning strategy and initial ability) is not mutually dependent or independent of one another in influencing student learning outcomes in Physics. So it can be concluded that guided inquiry learning strategies and discovery can be used in various situations in learning without considering high or low initial abilities. However, teachers must pay attention to the initial abilities or prerequisite materials in an effort to improve students' learning competence in Physics (Winarti et al., 2021).

The researcher is fully aware that there are still many shortcomings and limitations that occur in the implementation of this research, these limitations are as follows the learning competencies obtained in this study were only assessed from the effect of applying learning strategies and initial abilities, there were many other things that influenced not included in the study such as students' motivation, each student's interest in learning, gender, intelligence, or learning methods. every student is different. The results of the assessment on the competence of attitudes and skills that cannot be separated from the limitations of the observer in observing every aspect that is the focus of the assessment.

Conclusion

Based on the hypothesis testing that has been done, it can be concluded that: there are significant differences in physics learning outcomes between students whose learning uses guided inquiry and discovery strategies.

There is a significant difference in physics learning outcomes between students with high initial abilities and low initial abilities. There is no interaction between the use of learning strategies and initial abilities in influencing students' learning competence in Physics.

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Authors Contribution
Zakirman: Conceptualization, methodology, writing—original draft preparation, formal analysis, investigation, and visualization. Widiasih and Dodi Sukmayadi: validation, supervision, and resources. Rika Aprianti and Khoirotun Nadiyyah: writing—review and editing.

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Conflicts of Interest
The authors declare no conflict of interest.

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