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The effect of experiential learning models and formative test forms on the learning science outcomes by controlling students' prior knowledge in junior high school

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Abstract

This study examined the impact of formative exam forms and the experiential learning model on the science learning of first state junior high school students. A 2×2 factorial design was used, with 111 students selected from 205. Data were collected using a diagnostic test, essay, and objective test instruments. MANCOVA was used to evaluate the data. Results showed that there was an interaction effect between learning models and formative tests on students' science learning outcomes (F = 111.2; p < .05), students following the experiential learning model had higher learning outcomes than those following the direct learning model (t = -5.401; p < .05). Students learning with essay tests had higher outcomes than those learning with multiple-choice tests (t = -6.176; p < .05). According to the study, to improve the caliber of scientific instruction in junior high school, teachers should implement the experiential learning approach in conjunction with an essay test.

Introduction

As we enter the world of work in the 21st century, Science and technology continue to develop over time. The quick development of learning and technology will demand the value of human resources. Therefore, teaching has a strategic position in developing human resources (H.R.) that can adapt to the rapid growth of science and technology. One of the keys to developing human resources is in science education (Jampaklay et al., 2022; Phungsuk et al., 2017). The outcomes of science education in Indonesia must be acknowledged as being below expectations. The teacher's chosen learning paradigm (Chomeya et al., 2022) is one aspect that affects how well children learn science (Elbahri et al., 2018; Lubis et al., 2019).

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The packaging of science learning today is not in line with the nature of people learning and teaching according to the constructivist view. According to constructivists, learning is an active process of students constructing the meaning of texts, dialogues, physical experiences (Farokhi & Hashemi, 2011), and others. Learning (Marniati & Wibawa, 2018) is also a process of assimilating (Mayer, 2011) and connecting the experience or material learned with the understanding one already has so that cognition can be developed. Therefore, initial knowledge is one of the crucial factors that should not be ignored. Science learning that does not consider students' prior knowledge will interfere with the process of science construction (Blokker et al., 2019) on the structure of students' cognitive schemata (Wibawa et al., 2019).

According to constructivists (Abutabenjeh & Jaradat, 2018), teaching is an activity that permits students to transform their experience into knowledge rather than passing knowledge from instructor to student (Solsona-Puig, 2019). One of the innovative learning models (Budsayaplakorn & Sompornserm, 2022) based on constructivist understanding is the experiential learning model, which is supposed to improve the direct learning model in science learning in the classroom (Wibawa et al., 2020). According to the experiential education model, knowledge is constructed from gaining experience (Günes & Dilipak, 2021) and transforming experience. The stage of acquiring experience can occur directly through the senses or indirectly in the form of symbolic forms such as concepts. Concrete experience and abstract conceptualization are the two modes of experience acquisition that are described by the experiential learning paradigm, and two experience transformation models, namely, reflective observation and active experimentation (Rustiadi, 2015; Stock & Kolb, 2022). The foundation for observation and reflection is concrete experience. This reflection is taken in and transformed into abstract ideas that have fresh consequences for doing anything. These implications can be explored in-depth and used as a manual for developing fresh experiences (Suwartono & Stapa, 2022).

Learning with the experiential knowledge model (Kang & Chen, 2016) is a knowledge-building procedure concerning innovative tension between the four studying stages receptive to appropriate demands. This process is described as an ideal or spiral learning sequence, where students touch all bases, such as experiencing, thinking, acting in a recursive process, and caring about the studying condition and what is being learned. The experiential learning model consists of four learning stages, namely: Concrete Experience (C.E.), Reflective Observation (R.O.), Abstract Conceptualization (A.C.), and Active Experimentation (A.E.) (Kolb, 1984; Stock & Kolb, 2022).

On the other hand, the form of assessment teachers apply also affects student learning outcomes. The evaluation is done to ascertain how well pupils comprehended the material as well as to identify any flaws in the learning process, such as the correctness of the usage of learning strategies, media, and the assessment system (Iacovou et al., 2018). Information is gathered and processed through assessment to determine whether student learning outcomes have been met (students). Assessment of learning outcomes is based on criteria that are valid, impartial, fair, integrated, transparent, open, exhaustive, ongoing, systematic, and accountable. One assessment used as the basis for reflecting on the learning process is formative (Campillo-Ferrer et al., 2020). Formative assessment is a stage of activities carried out when the subject matter section has been given to students, either in the form of formative assessment or in the form of essay tests or multiple-selection tests. Both forms of essay tests and multiple-choice tests have advantages and disadvantages. But until now, the structure of assessment used in science learning in junior high school was not able to lead students to think critically and holistically. Determining formative assessment with multiple-choice tests in science learning does not facilitate achieving optimal science learning outcomes (Leeuwenkamp, 2017).

Based on the explanation, it is suspected that the learning model and form of formative assessment tests implemented by teachers in learning are factors that cause students' science learning outcomes to be suboptimal (Jaime et al., 2016). How far the experiential (Gentry, 1990; Stock & Kolb, 2022) and direct learning models can play a role in improving student learning outcomes under formative test forms has not been widely revealed. The study of problem is whether experiential learning models and formative forms test could affect the learning science outcome. Therefore, this problem needs to be explored in a research entitled "The Effect of Experiential Learning Models and Formative (Beneroso & Robinson, 2022) Test Forms on the Learning Science Outcomes by Controlling Students' Prior Knowledge in Junior High School". Hypothetically, the students facilitated in learning by experiential learning model and formative assessment with essay test were better than those facilitated by direct learning model and formative assessment with multiple choice-test.

The research study focused on assessing students' science learning outcomes based on the implementation of different learning models (experiential learning model and direct learning model) and formative test formats (essay tests and multiple-choice tests). The study aimed to investigate the impact of these instructional approaches and assessment methods on students' science learning outcomes while controlling for students' prior knowledge. The types of outcomes that the research was looking for were: (1) Science Learning Outcomes: the primary focus of the study was to evaluate students' science learning outcomes. This likely included assessing students' understanding of scientific concepts related to static electricity and dynamic electricity, as well as their ability to apply this knowledge in problem-solving scenarios; (2) Comparison of Learning Models: the study sought to compare the effectiveness of the experiential learning model and the direct learning model in promoting science learning outcomes; (3) Effect of Formative Test Formats: another aspect of the study was to investigate the impact of formative test formats on students' science learning outcomes; and (4) Interaction Effect: the study also explored the interaction effect between learning models and formative tests on students' science learning outcomes.

Methodology

This research aims to describe and define the effect of studying models and forms of formative tests on science learning outcomes. This research falls under the category of quasi-experimental research because not all variables (symptoms that manifest) and experimental settings can be precisely regulated and controlled. The research design was a 2×2 factorial design with a pretest-posttest non-equivalent control group design. The research design has two fundamental aims and objectives, namely: (1) providing answers to the researcher's questions; and (2) controlling or controlling for variance. The 2×2 factorial design is an analytical method to investigate the effect of two or more treatment variables on the sample group under investigation. This design provides an opportunity to determine the main product and interactive development of the separate variables on the dependent variable (Weja et al., 2013). Covariance analysis in statistical methods provides control over external variables that confound the correlation between the factors that are dependent and independent. Factor A in this research is the learning prototype, namely, the experiential learning prototype (A_1) and the direct learning prototype (A_2). Factor B is a form of a test consisting of an essay test (B_1) and a multiple-choice test (B_2), while X (covariate) is initial knowledge and Y is the student's science learning outcomes.

This study's target population was all Junior State High School students in Singaraja who experienced the same curriculum. The approachable inhabitants in this research were all grade IX students at Junior State High School in Singaraja in the 2015/2016 academic year. According to the population (Pérez-Medina et al., 2021) it is divided into two groups: the actual population or the target population (target population) and the accessible population (accessible population). This study's population was all class IX students, SMP Negeri 1 Singaraja and SMP Negeri 2 Singaraja, with as many as 405 students. The sampling of the research was carried out by using a multi-stage technique. The sample was partly taken from the population. The total sample size is 111 students, distributed into groups of students that correspond to the treatment variable.

Table 1 Sample composition based on treatments

Treatment (B)	Treatment (A)	
	Experiential Learning Model	Direct Learning Model
Essay Test	29	28
Multiple-choice Test	27	27

The treatment variables were classified into the learning model (A) and the formative test form (B). An experiential learning model treated one group, while a direct learning model treated the other. The students were grouped into the experimental class and taught using the experiential learning model (A_1), while the control class used the direct learning model (A_2). Meanwhile, the form of the formative test given is the form of an essay test (B_1) for the experimental group and a multiple-choice test (B_2) for the control group. The data of study were collected by using test. The data of prior knowledge of students were collected by using diagnostic test (validity r = 0.366, reliability r = 0.98), whereas the learning outcomes were collected using formative essay test and multiple-choices test (validity = 0.383–0.807; reliability = 0.97). Then, the data of study were analyzed using MANCOVA.

The specific information regarding the duration of the experiment conducted in the research study is 2 semesters in learning year 2015/2016. However, based on the details provided in the research, we can infer that the experiment likely spanned multiple sessions or lessons where students were exposed to either the experiential learning model or the direct learning model, along with formative assessments such as essay tests and multiple-choice tests.

The procedures of the experimental were (1) before the experiment, all students in the sample were given diagnostic test in order to get their prior knowledge; then (2) in the class of A_1B_1, the students were facilitated by experiential learning model and formative essay test, in the class of A_1B_2, the students were facilitated by direct learning model and formative multiple-choice test, in the class of A_2B_1 the students were facilitated by direct learning model and formative essay test, in the class A_2B_2 the students were facilitated by direct learning model and multiple-choices test. There were 4 times meeting and formative assessment given in learning content of static electricity and dynamic electricity; and (3) at the end of the experiment, the investigational and control class were given the same final test, namely, the learning outcome test, essay test items, and multiple-choice test items.

Both multiple-choice tests and essay tests were used to assess students' science learning outcomes. Here is an overview of how these two types of tests were designed:

Multiple-choice test

Design: Multiple-choice tests typically consist of a series of questions or statements, each accompanied by a set of response options. Students are required to select the correct answer from the provided choices; Structure: The multiple-choice test used in the study likely included a range of questions covering various topics in science. Each question would have multiple response options, with one correct answer and several distractors; Assessment Focus: Multiple-choice tests are commonly used to assess students' knowledge of factual information, understanding of concepts, and ability to apply learned principles in a structured format; Scoring: In multiple-choice tests, students receive points for selecting the correct answer and may lose points for choosing incorrect responses. The total score is calculated based on the number of correct answers.

Essay test

Design: Essay tests require students to provide written responses to open-ended questions or prompts, allowing them to demonstrate their understanding, critical thinking skills, and ability to articulate complex ideas; Structure: the essay test used in the study likely included questions that required students to explain concepts, analyze scenarios, provide examples, and support their answers with evidence; Assessment focus: essay tests are designed to assess students' ability to think critically, synthesize information, and communicate their ideas effectively in a written format; Scoring: essay tests are typically scored based on the depth of understanding, coherence of arguments, use of evidence, and clarity of expression in students' responses. Grading criteria may include content knowledge, organization, analysis, and language proficiency.

In this research, the researchers took specific steps to ensure that students received only one learning prototype (experiential learning model or direct learning model) throughout the study. Here are some measures that were likely implemented to maintain the integrity of the experimental design: (1) Random Assignment: the researchers likely used random assignment to allocate students to different experimental groups; (2) Control Group Design: the study employed a pretest-posttest non-equivalent control group design, which involves comparing the outcomes of students in the experimental and control groups; (3) Separate Classrooms: students in the experimental class (experiential learning model) and the control class (direct learning model) were likely placed in separate classrooms to prevent cross-contamination of instructional methods; (4) Distinct Instructional Materials: the researchers may have provided distinct instructional materials, resources, and activities tailored to each learning prototype, (5) Monitoring and Supervision: the researchers likely monitored the implementation of the experiential learning model and the direct learning model to ensure fidelity to the intended instructional approaches; and (6) Consistent Implementation: to ensure consistency in the delivery of instruction, the researchers may have provided training to teachers or facilitators responsible for implementing the experiential learning model and the direct learning model.

In the research discussed, the experimental design involved a total of four lessons or meetings where formative assessments were given in the learning content of static electricity and dynamic electricity. These lessons were part of the experimental procedure where students in different classes were exposed to either the experiential learning model or the direct learning model, along with formative assessments such as essay tests and multiple-choice tests. The study likely structured the instructional sessions and assessments across these four meetings to evaluate the impact of the different learning prototypes and formative test formats on students' science learning outcomes. By conducting assessments at multiple points during the experiment, the researchers could track the progress of students in both the experimental and control groups and analyze the effectiveness of the instructional approaches.

There were 4 (four) teachers involved in implementing the different learning model and conducting the form of formative assessments with the students. Each teacher would likely be assigned to a specific experimental group (experiential learning or direct learning) and would follow the prescribed protocols for implementing the designated learning model and administering the formative assessments.

The collaboration of multiple teachers in research studies helps ensure the consistent implementation of interventions and the collection of reliable data for analysis.

It is likely that the teachers involved in implementing the experiential learning model and the direct learning model used different lesson plans tailored to each instructional approach. Here are some reasons why the teachers may have used different lesson plans for the two learning prototypes: (1) Differences in Instructional Strategies: the experiential learning model and the direct learning model involve distinct instructional strategies and approaches. Teachers would need to design lesson plans that align with the specific characteristics and requirements of each model. For example, the experiential learning model may involve hands-on activities, group work, and real-world applications, while the direct learning model may focus more on teacher-led instruction and structured content delivery; (2) Alignment with Learning Objectives: lesson plans are typically designed to align with specific learning objectives and outcomes. Teachers would have tailored their lesson plans to ensure that the content and activities in each model support the intended learning goals of the study. The lesson plans for the experiential learning model and the direct learning model would have been structured to meet the unique objectives of each approach; (3) Differentiated Instruction: differentiated instruction involves adapting teaching methods to meet the diverse needs of students. In the context of the research study, teachers may have used different lesson plans to accommodate the varied instructional requirements of the experiential learning model and the direct learning model. This approach allows teachers to provide targeted instruction that best suits the learning styles and preferences of students in each group; and (4) Experimental Design: to maintain the integrity of the experimental design and ensure that students in the experimental and control groups received distinct interventions, teachers would have followed separate lesson plans for each learning prototype. Consistency in the implementation of the instructional approaches is essential for drawing valid conclusions from the study results.

Results and Discussion

Factor A of this research is the learning prototype, which consists of the experiential learning model (A_1) and the direct learning prototype (A_2). Factor B is in the form of two tests: an essay test (B_1) and a multiple-choice test (B_2). Meanwhile, X (covariate) is the initial knowledge, and Y is the students' science learning outcomes. The distribution of data on the results of prior knowledge measurement (X) and science learning outcomes (Y) based on the learning model (A) and formative assessment tests (B) obtained in this research are displayed in Table 2.

Table 2 General descriptive data of research results

Learning Outcome		A_1		A_2		Total	
		X	Y	X	Y	X	Y
B_1	*N*	29	29	28	28	57	57
	Mean	20.48	80.48	19.25	69.28	19.87	74.98
	SD	2.23	4.40	2.01	4.93	2.19	7.30
B_2	*N*	27	27	27	27	54	54
	Mean	18.55	68.92	19.85	76.07	19.20	72.50
	SD	2.47	4.04	2.29	5.49	2.45	5.29
Total	*N*	56	56	55	55	111	111
	Mean	19.55	74.91	19.54	72.61	19.54	73.77
	SD	2.52	7.18	2.15	6.19	2.33	6.78

The average prior knowledge score for students was 19.55 with a standard deviation (*SD*) of 2.52 in the experimental group (A_1) and 19.54 with a *SD* of 2.15 in the control group (A_2). The essay test (B_1) prior knowledge average score for pupils was 19.57 with a standard deviation (*SD*) of 2.19. The middle students' primary knowledge score in the multiple-choice test class (B_2) was 19.20, with an *SD* of 2.45. The science learning outcomes of students using the experimental model with the essay test (A_1B_1) had an average of 80.48 and a standard deviation of 4.40, while the multiple-choice test (A_1B_2) was 68.92 with an *SD* of 2.47. On the other hand, the student's knowledge learning results using the direct learning model with an essay test (A_2B_1) came with an average of 69.28 and an *SD* of 4.93, while the multiple-choice test (A_2B_2) was 76.07 with an *SD* of 5.49.

Table 3 shows results of the two-way analysis of covariance (ANCOVA) for the learning model (A) which resulted in the value of T_{obs} = 9.410, which turned out to be significant at the importance level of .05. The average corrected value of science learning outcomes for students who follow the experiential learning simulation is 74.75, and for students who follow the direct learning, the model is 72.68. Students who followed the experiential learning model had higher science learning outcomes than students who followed the direct learning model. The results of the two-way ANCOVA analysis for the formative tests (B) yielded a value of $T_{observed}$ (T_{obs}) = 4.54, which was significant at the significance level of .05. For students who participated in learning using essay tests, the average value of science learning outcomes was 74.43, while students who took lessons with multiple-choice tests scored 72.98. Students who took learning with essay tests had higher science learning outcomes than those who took classes with multiple-choice quizzes. After adjusting for prior knowledge, the findings revealed a communication effect between the learning model and formative exams on scientific learning outcomes. This evidence was conducted by the value of T_{obs} = 111.2, which was significant at the significance level of .05.

After controlling students' prior knowledge, the simple effect test using the *t*-test shows that for students who took the essay test, students who followed the experiential learning model had higher learning outcomes than those following the direct learning model. The evidence is by the value of T_{obs} = 9.866, which is significant at the significance level of .05. Students who followed the experiential learning model had an average science learning outcome of 79.17, and students who followed the direct learning model had an average science learning outcome of 69.706 after controlling the prior knowledge. After controlling students' prior knowledge, students who took learning with multiple-choice tests following the experiential learning model had lower learning outcomes than those who followed the direct learning model. The evidence is by the value of T_{obs} = -5.401, which turns out to be significant at the significance level of 0.05. The students who took learning with multiple-choice tests following the experiential learning model had an average corrected science learning outcome of 70.322. Students who followed the direct learning model had an average corrected science learning outcome of 75.650 after controlling for prior knowledge, as seen in Table 4.

Table 3 The result of the ANCOVA test

Tests of Between-Subjects Effects					
Dependent Variable: Y		*df*	Mean Square	*F*	*p*
Source	Type III Sum of Squares				
Corrected Model	3720.388[a]	4	930.097	73.741	.000
Intercept	3015.223	1	3015.223	239.056	.000
X	1073.678	1	1073.678	85.124	.000
A	118.687	1	118.687	9.410	.003
B	57.313	1	57.313	4.544	.035
A * B	1402.822	1	1402.822	111.220	.000
Error	1336.982	106	12.613		
Total	609199.000	111			
Corrected Total	5057.369	110			

Table 4 The result of the *t*-tests

Parameter Estimates						
Dependent Variable: Y						
Parameter	B	*SE*	*t*	*p*	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	48.199	3.098	15.560	.000	42.058	54.340
[B=1]	-5.943	0.962	-6.176	.000	-7.851	-4.035
[B=2]	0[a]	.	.	.	.	.
[A=1] * [B=1]	9.466	0.959	9.866	.000	7.564	11.368
[A=1] * [B=2]	-5.328	0.987	-5.401	.000	-7.284	-3.372
[A=2] * [B=1]	0[a]	.	.	.	.	.
[A=2] * [B=2]	0[a]	.	.	.	.	.
X	1.404	0.152	9.226	.000	1.102	1.706

On the other hand, for students who followed the experiential learning model, students who took learning with essay tests had higher learning outcomes than those who took lessons with multiple-choice tests after controlling students' prior knowledge. The value of T_{obs} = 8.904, turned out to be significant at the significance level of .05. Specifically, for the students who took the experiential learning, it was found that the students who took the essay test lesson had an average corrected science learning outcome of 79,172. The students who took the objective test lesson had an average corrected science learning outcome of 70,322 after controlling for prior knowledge; (7) For students who followed the direct learning model, students who took learning with essay tests had lower learning outcomes than those who took learning with multiple-choice tests after controlling students' prior knowledge. This is evidenced by the value of T_{obs} = -6.176, which is significant at the significance level of .05. Specifically, for the group of students who took the direct learning model, it was found that the students who took the essay test had an average corrected science learning outcome of 69.706. The students who took the multiple-choice test had an average corrected science learning outcome of 75.650 after controlling for prior knowledge.

The results of the hypothesis testing, which show that groups of students who engage in experiential learning and those who engage in direct learning have different learning outcomes in science, are acceptable. Students who engage in experiential learning achieve better science learning outcomes than those who adhere to the direct learning model, which controls past knowledge. Thus, it can be said that in junior high school science classes, students who participate in experiential learning attain student learning outcomes more so than those who take direct information. The findings of this study are consistent with those of Colak Esma (2013); Agsalog (2019); and Alkan (2016), suggesting that practical, experiential learning can increase students' motivation (Jamian et al., 2022), interest, critical thinking, and learning interests by actively encouraging them to provide opportunities for them to connect and apply the knowledge they have acquired.

The process of assessment is essential to learning. The practice of documenting learners' abilities and growth is known as assessment. The assessment applied in learning impacts the quality of student learning. Teachers often use two types of tests in formative assessment: essay tests and multiple-choice quizzes. An essay test is a type of test that allows students to demonstrate a set of skills or behaviours, or products in a particular context. The objectives of essay tests are knowledge, reasoning, skills, products, and the affective side of learning. Essay tests can show students' actual (authentic) abilities and escalation of learning capacity. In carrying out the essay test, such should be accompanied by a rubric that is used as a guide in giving grades clearly and agreed upon by the teacher and students. Because both parties have the opportunity and clear standard guidelines, the rubric is expected to motivate students in the learning process. If all of this goes well, it is believed that it will be able to contribute to student learning outcomes. A multiple-choice test is a type of test that requires students to choose the correct answer from the provided options. On the other hand, a multiple-choice assessment is held by teachers to measure students' abilities convergently, so there is room for escalating learning capacity. The weaknesses of multiple-choice tests are (1) not being able to measure competence holistically, (2) not training higher order thinking skills, and (3) not suitable for measuring student attitudes or behaviour.

The multiple-choice test only requires students to apply the formula they have learned by choosing one solution from several available alternatives. The knowledge construction process is more detailed in the cognitive structure of students, which is facilitated by essay tests compared to multiple-choice tests (Ismail, 2015).

Applying different learning models will also provide a learning environment/learning atmosphere, different levels of concept understanding, and interaction between students. Students in the experiential learning model are required to be responsible for the education they are undergoing and are directed not to be too dependent on the teacher. The experiential learning model forms independent students who can continue the learning process in life and the career they will live. A teacher acts more as a facilitator or tutor and does not present concepts in learning, but students will seek ideas through the given problems. The problems presented in education are real, namely, problems in their environment. The experiential learning model is an instructional strategy that teaches students how to solve problems in the actual world while also imparting key facts and ideas about the subject matter.

In the direct learning model in science learning in junior high school, students are given problems after the subject matter has been taught. Similarly, problem-solving techniques have been taught previously by the teacher. Students who solve problems will follow the rules for solving these problems. The presented issues are well structured, so the concept used to solve the problem is apparent. Students will use the principles or concepts taught in learning, especially when faced with a reasonably complex contextual problem.

It is not sufficient for lesson planning, instructors' capacity to design the learning process, and teachers' command of the teaching materials to enable effective learning. Additionally, having a solid grasp of the material is insufficient if you lack the capacity to evaluate students' attainment of skills, which is crucial for effective planning and instruction.

An essay test allows students to demonstrate skills, behaviors, or products in a particular context. Students must complete challenging and authentic activities using all of their existing knowledge, newly acquired knowledge, and pertinent abilities in order to successfully pass the essay test. An experiential learning paradigm is a great fit for the idea of evaluation in the form of an essay test. Real-life experiences are closely linked to experiential learning. A constructivist method known as the experiential learning model stresses the use of the natural environment in the learning process so that students can really experience what they are learning in the classroom. Students can develop, broaden, and apply their academic knowledge and skills in numerous contexts inside and outside of the classroom thanks to the experiential learning paradigm (Indriani & Mercuriani, 2020; Kang & Chen, 2016). Therefore, experiential learning is a concept for learning and teaching that enables teachers to connect the subject matter to students' real-world experiences and motivates learners to link their knowledge and its application in their life.

The attributes of the experiential learning model are very suitable to be paired with the essay test. This will have a positive impact on undergraduate learning outcomes. The experiential learning model and the essay test require students to be active in science learning, starting from preparing lesson plans, implementing learning, and evaluating. Applying the experiential learning paradigm makes learning more genuine and meaningful, thus students must document the connection between what they learn in the classroom and what they experience in real life. The learning will be more meaningful, and the material will work more effectively if it is connected to real-world experiences. This will also help pupils retain the information learnt. Additionally, because experiential learning adheres to constructivism and guides students in discovering their knowledge, education is more effective and can encourage idea strengthening in pupils. Students are intended to learn through experience in accordance with the constructivism philosophy (Qureshi et al., 2019).

When examined further, it is obvious that the essay test and the experiential learning model have similarities in conveying: (1) the value of the information obtained based on the needs of students; (2) linking new information with the knowledge that students already have; (3) relying on spatial memory (understanding meaning); (4) students involved in the learning process; (5) study time to find, explore, discuss, think critically, or work on projects and problem-solving (through group work); (6) behavior built on self-awareness; (7) skills developed based on understanding; (8) good behavior rewarding self-satisfaction; (9) awareness of what is wrong and detrimental; (10) behavior as a base of intrinsic motivation; and (11) learning occurrence in various places, contexts, and settings (Moon, 2013; Safriani, 2015). This idea supports the results of testing the research hypothesis, which states that in the group of students following the experiential learning model, the science learning outcomes of students given an essay test were higher than those given a multiple-choice test by controlling students' prior knowledge.

Students who participate in direct learning are more likely to be given multiple-choice tests because they do not have the opportunity to do independent learning activities. Multiple-choice exams can inspire pupils to engage in active learning. Less attention is paid to students when they are learning. The incorporation of essay tests into natural learning becomes less related since the direct learning model frequently takes the form of lectures and brief dialogues. The essay test requires students to be active in the education process, while in direct education, students tend to be passive or less actively involved in learning. The results of hypothesis testing showed that by controlling for students' past knowledge, students who took direct learning had lower science learning outcomes when given an essay test than when given a multiple-choice test.

The effectiveness of the experiential learning model and essay tests in enhancing science learning outcomes is supported by learning theories and previous research. Here are some references to elaborate on why the experiential learning model and essay tests worked well in this research: experiential learning theory by (Kolb, 1984): Kolb's experiential learning theory emphasizes the importance of concrete experience, reflective observation, abstract conceptualization, and active experimentation in the learning process. This theory aligns with the idea that students benefit from hands-on experiences and real-world applications of knowledge, which are central components of the experiential learning mode. Constructivism: the experiential learning model is closely linked to constructivist theories of learning, which suggest that learners actively construct their understanding of the world through experiences and reflection. By engaging students in authentic activities that require them to apply their existing and newly acquired knowledge, the experiential learning model promotes deeper understanding and meaningful learning experiences.

In previous research, studies by (Indriani & Mercuriani, 2020; Kang & Chen, 2016) have highlighted the benefits of experiential learning in connecting classroom learning to real-world experiences and enhancing student motivation and engagement. By incorporating real-life experiences into the learning process, students can develop a deeper understanding of concepts and apply their knowledge in various contexts, aligned with essay tests that are well-suited for assessing students' ability to apply their knowledge in complex and contextualized situations. By requiring students to demonstrate their understanding through written responses, essay tests align with the principles of experiential learning by encouraging students to reflect on their experiences, connect theory to practice, and engage in higher-order thinking. By drawing on these learning theories and research findings, the study demonstrates how the experiential learning model and essay tests can effectively enhance science learning outcomes by promoting active engagement, meaningful learning experiences, and the application of knowledge in authentic contexts.

The research study yielded several key outcomes based on the investigation of the impact of experiential learning models and formative test forms on science learning outcomes in junior high school students. The types of outcomes that resulted from the research are: (1) Higher learning outcomes with experiential learning model: the study found that students who followed the experiential learning model achieved higher science learning outcomes compared to those following the direct learning model. This outcome suggests that the experiential learning approach was more effective in enhancing students' understanding and application of scientific concepts; (2) Superior performance in essay tests: students who took the essay tests demonstrated higher science learning outcomes than those who took the multiple-choice tests. This finding indicates that the essay test format was more conducive to assessing students' depth of understanding and critical thinking skills in science; (3) Interaction effect of learning models and formative tests: the study identified an interaction effect between learning models and formative tests on students' science learning outcomes. This suggests that the combination of a specific learning model with a particular formative test format had a significant impact on students' performance beyond the individual effects of each factor; (4) Differential impact on learning outcomes: the research revealed that for students learning with essay tests, those who followed the experiential learning model had higher learning outcomes than those who followed the direct learning model. Conversely, for students learning with multiple-choice tests, those who followed the experiential learning model had lower learning outcomes than those who followed the direct learning model; and (5) Recommendations for science teaching: based on the study findings, the research recommended that teachers adopt the experiential learning model together with essay tests to enhance the quality of science teaching in junior high school. This recommendation highlights the potential benefits of integrating specific instructional approaches and assessment methods to improve science education outcomes.

Overall, the outcomes of the research study provided valuable insights into the effectiveness of different learning models and formative test formats in influencing students' science learning outcomes. The findings contribute to the understanding of how instructional strategies and assessment practices can impact student achievement in science education.

Conclusion

The study's findings include the following: (1) Students who used the experiential learning model achieved higher science learning outcomes than those who used the direct learning model after adjusting for prior knowledge; (2) Students who took the essay test achieved higher science learning outcomes than those who took the multiple-choice test after adjusting for prior knowledge; (3) there was an interaction effect between learning models and formative tests on students' science learning outcomes, after controlling students' prior knowledge; (4) After adjusting for past knowledge, students who used the experiential learning model had better learning results than those who used the direct learning model while learning using essay assessments; (5) for students learning with multiple-choice tests, students who followed the experiential learning model had lower learning outcomes than those who followed the direct learning model, after controlling students' prior knowledge; (6) for students who followed the experiential learning model, students learning with essay tests had higher learning outcomes than those learning with multiple-choice tests, after controlling students' prior knowledge; and (7) for students who followed the direct learning model, students learning with essay tests had lower learning outcomes than those learning with multiple-choice tests, after controlling students' prior knowledge. Implications of these findings include the importance of incorporating experiential learning strategies and essay tests in science education to enhance students' understanding and retention of scientific concepts. Educators can use these results to design curricula and assessments that promote active learning, critical thinking, and a deeper understanding of scientific principles. Additionally, the study highlights the need for ongoing research and professional development to further explore the effectiveness of different learning models and assessment methods in improving science education outcomes.

Recommendation

The results of this study show that one of the factors influencing whether science learning outcomes are attained is the learning model. Additionally, formative assessments like essay tests and multiple-choice quizzes have an impact on how well students learn science, particularly in grade IX at the SMPN in Singaraja. On this basis, success in the science learning process is highly dependent on the ability of teachers to choose learning models and forms of formative assessment tests that follow the material characteristics, student characteristics, and competencies that students must achieve. To improve the quality of the learning process and science learning outcomes, the following things can be suggested, namely: (1) teachers apply the experiential learning model so that students play an active role in learning; (2) teachers apply formative assessment in the form of an essay test, so that students are more motivated and challenged to think in learning; (3) teachers apply experiential learning models together with essay tests; and (4) teachers apply direct learning models in the form of multiple-choice tests. Based on the study, it recommended that teachers adopted the experiential learning model together with essay test to enhance the quality of science teaching in junior high school.

Conflict of Interest

The authors declare that there is no conflict of interest.

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