
AN EVALUATION OF IMPLEMENTATION OF THE DISCOVERY LEARNING MODEL ON NATURAL SCIENCE LEARNING

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Abstract:

This study analyzes the quality of preparation, process, and learning outcomes in applying the discovery learning model. The method used in this research was evaluation with the Countenance Stake model. The population of this research was natural science students and teachers throughout Indonesia. The sample was the seventh-grade students from Sleman Regency and teachers representing several provinces. Data collection was through document review, observation sheets, and teacher and student questionnaires. Data were analyzed using qualitative descriptive technique. The results of this study indicated that the quality of the preparation and implementation process of the discovery learning model was quite good. Student learning outcomes were fairly good but had not applied assessments of critical skill, problem-solving, creativity, and innovation as a requirement of 21st-century learning evaluation. The study results were expected to provide an overview of the quality of teacher preparation, process, and learning outcomes in applying the discovery learning model.

Abstrak:

Penelitian ini bertujuan untuk menganalisis kualitas persiapan, proses, dan hasil belajar dalam menerapkan model discovery learning. Metode yang digunakan dalam penelitian ini adalah penelitian evaluasi dengan model Countenance Stake. Populasi penelitian ini adalah siswa dan guru IPA se-Indonesia dengan sample siswa berasal dari Kabupaten Sleman serta guru dari perwakilan beberapa provinsi. Pengumpulan data menggunakan lembar telaah dokumen, lembar observasi, angket guru, dan angket siswa. Data dianalisis dengan teknik deskriptif kualitatif. Hasil penelitian ini menunjukkan bahwa kualitas persiapan dan proses pelaksanaan model discovery learning sudah cukup baik. Hasil belajar siswa cukup baik, namun belum menerapkan penilaian keterampilan kritis, pemecahan masalah, kreativitas dan inovasi sebagai tuntutan dalam penilaian pembelajaran abad 21. Hasil penelitian diharapkan dapat memberikan gambaran umum tentang kualitas persiapan, proses, dan hasil belajar guru dalam menerapkan model discovery learning.

Keywords:

Countenance Stake, Discovery Learning, Evaluation

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INTRODUCTION

As technological developments, research has also undergone significant developments. There are so many institutions that accommodate researchers to publish research results. Most educational research is dominated by learning development research, which includes developing models, strategies, media, assessments, and research that applies the findings of other researchers to study the resulting impact on certain groups. In addition, another research topic that also has a significant role in decision-making is evaluation research. Evaluation research is a type of research that aims to see the suitability between implementation and planning based on specific standards (Ralph, 2016; Wraga, 2017). Tatum (2019) stated that the evaluation results could provide an overview of the implementation of a program, so it can be helpful to provide recommendations for the program's sustainability (Suhendi, Mulhayatiah, & Zakwandi, 2018). Learning that takes place in class is one form of program. The learning program is defined as a series of planned activities in which implementation takes place on an ongoing basis and involves all components in learning to achieve learning objectives (Kalathaki, 2015). Learning activities need to be carried out on an ongoing basis to run effectively and efficiently, including preparation, implementation, and evaluation (Lukum, 2015).

Good learning requires serious planning in which the teacher arranges learning activities (Kemendikbud, 2019b). In Indonesia, the implementation of science learning at the junior high school level is integrated with a scientific approach (Dewi, Suryadarma, Wilujeng, & Wahyuningsih 2017; Isdaryanti, Rahman, Sukestiyarno, Florentinus, & Widodo, 2018; Rahmania & Kaniawati, 2017). Science learning at the junior high school level can increase learning motivation, foster curiosity, and practice thinking skills (Murnawianto, Sarwanto, & Rahardjo, 2017). In addition, Trumper (2006) reported that students need to study science to improve their careers and have a clear attachment to life. Implementation of learning began with preliminary activity, followed by a core activity, and finished by closing activities. These activities were done by selecting learning models to strengthen the scientific approach (Chusni, Setya, Agustina, & Malik, 2017). Thus, it can be concluded that the appropriateness of the stages of learning implementation with the learning model and curriculum is the standard of success in program implementation.

Problems encountered were that teachers did not understand the characters of science and how it can be taught in class. Science teachers generally design science learning, not following its nature, namely scientific inquiry, which results in material misconceptions (Hidayatulloh, Humairoh, Wachidah, Iswati, & Suliyanah, 2015). They also pay less attention to the psychological state from the beginning to the evaluation at the end of learning, which makes learning science less significant (Agustina, Chusni, & Ijharudin, 2019). Besides, teachers are still not optimal in applying learning models that strengthen scientific approaches such as discovery learning, difficulty determining teaching aids that follow the material being taught, and often verbalizes (Chusni, Rahardjo, & Saputro, 2020; Widuri, Chusni, & Yuningsih, 2019).

Based on preliminary studies conducted that there was still some material for natural science subjects in Sleman Regency, its absorption capacity was relatively low, as shown in table 1.

Table 1. The Students' Abilities to Absorb Natural Science Material

Material tested	The Ability of Student to Absorb Material at a Level (%)		
	Districts	Province	National
Measurements, Substances, and Their Properties	63.26	61.13	47.47
Mechanics and Solar System	71.60	69.79	53.04
Waves, Electricity, and Magnetism	45.56	44.52	32.19
Living things and Their Environment	71.38	69.93	56.39
Structure and Function of Living Things	63.57	62.29	50.41

Source: (Kemendikbud, 2019a)

Table 1 shows the materials tested. The percentages at the district level were higher than at the provincial and national levels. Regarding the natural science material tested, wave material, electricity, and magnetism were the lowest answered materials at the district, provincial and national levels. At the district level, it only reached 45.56%, at the provincial level, it only reached 44.52%, and at the national level, it only reached 32.19%.

Absorption shows that the science learning program is essential to evaluate because the science learning function can change the mindset of students into critical thinking (Miterianifa & Saputro, 2020), creative (Listiana & Bahri, 2019), and innovative (Asrizal, Amran, Ananda, Festiyed, & Sumarmin, 2018). The appropriate evaluation model used in this study is the Countenance Stake evaluation model (Tompong & Jailani, 2019). It will give a complete description and consideration of the teachers' learning of science that focuses on the antecedent that is the planning process made by the teacher (Al-Azawei & Al-Masoudy, 2020; Wong, Gillan, Harnett, & Li, 2017). The transaction is the process of instruction activities, and the outcome is the effect of experience, observation, and work results.

Problems regarding the discovery learning model implementation had not been the main focus in many studies. Several researchers have focused on developing instruments (Saragih, Napitupulu, & Fauzi, 2017), instructional (Simamora, Saragih, & Siregar, 2019), and media (Sundayana, Herman, Dahlan, & Prahmana, 2017). Thus, the main point of this study was the problem in implementing learning using the discovery learning model, either before or after being optimized by many researchers, needed to be analyzed comprehensively in order to direct solving problems related to science learning, especially by using the discovery learning model, becomes more systematic.

RESEARCH METHOD

The research method used was a descriptive evaluation using Countenance Stake Model. This model analyzed the evaluation process that emphasized two kinds of operations, namely descriptions and judgments, then distinguished into three stages: antecedents, transactions, and outcomes. The description matrix was related to the intense science learning program and the results of observation of the program in schools. The judgment matrix was related to the standards or criteria, namely Permendikbud Number 65 of 2019, concerning learning process standards and judgment evaluators. The most significant emphasis on this model was the opinion that evaluators decide the program being evaluated. The design of this study used the countenance evaluation model, as shown in figure 1.

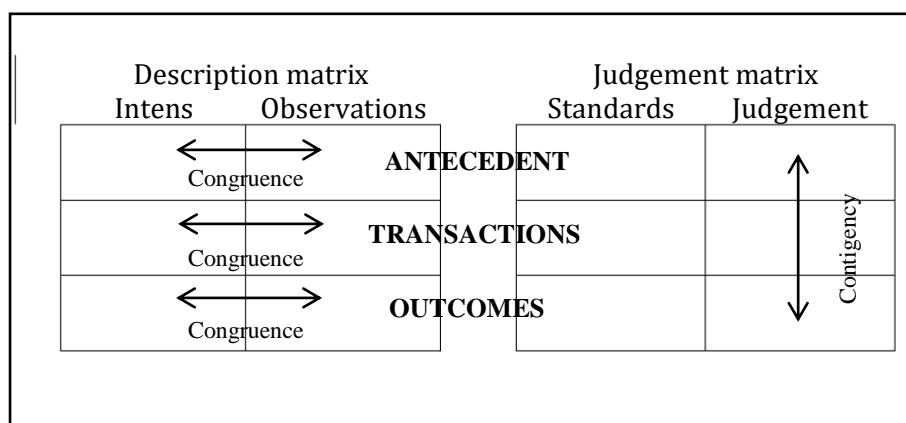


Figure 1. Evaluation of the Countenance Stake Model (Stake, 1976)

The Countenance Stake model consisted of four steps: the initial step, collecting data, logical analysis, and empirical analysis. The first step was to compile learning programs of natural science for the seventh-grade students in Sleman district. In this section, preliminary data were collected related to the programs implemented by teachers, including planning, implementing, and learning outcomes of students based on theoretical studies, support of applicable regulations, and the actual conditions of schools.

The second step is collecting data. This intense data collection was carried out to obtain information about junior high school science learning programs and the expected effects. This objective analysis was also done in three parts of the evaluation component, namely antecedents, transactions, and outcomes. The analysis was carried out by considering the objective conditions of the program and then processing the description matrix data with two concepts, namely contingency and congruence. These two concepts differed in their use. The contingency was used to analyze data vertically, looking for the relationship between antecedents, transactions, and outcomes. Contingency analysis is done in two ways: logical connection and empirical connection.

The next step was a logical analysis of the data. It was used to consider the relationship between antecedents, transactions, and the results of natural science learning contained in the intents matrix. This analysis found that lesson plans made by

science teachers as an initial requirement in the science learning program achieved the proposed transaction plans, likewise, regarding the relationship between the implementation of learning with the expected science learning outcomes.

The last step was the empirical analysis which was carried out to consider the relationship between antecedents, transactions, and learning outcomes. This analysis was based on empirical data obtained in the field. Moreover, researchers then considered the suitability and differences between planning and those in the field (school) to look for contingencies. Congruence analysis was carried out in advance by developing standards for measuring the program's implementation at all evaluation stages by setting clear and measurable criteria. The standard to be used was based on theoretical and practical considerations in field conditions. Analysis of the suitability of the standard with the research data was the basis for judgment. This decision-making was done for the three evaluation components: antecedents, transactions, and outcomes. Then, this research would provide recommendations and considerations based on the evaluation results.

The participants in this research were teachers from several provinces in Indonesia and the seventh-grade students of junior high school in Sleman district. Data collection was done through observation, documentation, and interview techniques. Observation aimed to investigate the learning in the class, including preliminary activities, core activities, and closing activities using observation sheets following the standard process. The observers were researchers and principals who aimed to find the credibility of the observation, and it could be trusted, considering the principal was more aware of the condition of the school. Documentation was used to assess lesson plans made by science teachers. Lesson plan assessment was done by giving a score according to the quantification of the availability of the lesson plan used for data on daily grades, midterm, and final semester exams. The instrument used is the instrument listed in the process standard. Also, study documents are used for data on daily grades, midterm, and end-of-semester exams. The instrument used was listed in the Permendikbud learning process standard Number 65 of 2019, consisting of standards for planning, implementing, and evaluating learning outcomes. Interviews were conducted with teachers and school principals to obtain data on teacher readiness in planning and implementing learning as well as the efforts of principals in implementing their supervision on science learning.

Data analysis in this research used descriptive qualitative. Qualitative data were analyzed using a thematic analysis that compares data at three stages of Stake: antecedent, transaction, and outcomes in the description matrix with the standards in the consideration matrix, then concluded. In this thematic analysis, flow analysis consisted of data collection, reduction, verification, and conclusions.

RESULTS AND DISCUSSION

Congruence on Antecedent Components

The component evaluated in this antecedent was the lesson plan made by the science teachers in the four targeted schools. The following was the antecedent component countenance matrix presented in table 2.

Table 2. Countenance Matrix Antecedent Component

Description Matrix		Judgment Matrix	
Intense	Observation	Standards	Judgments
The lesson plans with the syntax of the discovery learning model, made by the science teacher, followed Permendikbud Number 65 of 2019 about process standards.	The actuality of the achievement of the lesson plans made by science teachers was 80.03, categorized as good. Most science teachers had planned learning according to the criteria set out in the Permendikbud number 65 of 2019.	The components of the lesson plans based on the Learning Process Standards include: 1) School identity; 2) Identity of subjects; 3) subject of materials; 4) time allocation; 5) learning objectives; 6) essential competencies and indicators; 7) learning material; 8) learning methods; 9) learning media to help the process of delivering subject matter; 10) learning resources, i.e., books, print, and electronic media, or others; 11) step-by-step learning process, including the preliminary, core, and closing stages; 12) the assessment.	Most of the lesson plans made by natural science teachers were not following Permendikbud Number 65 of 2019 about process standards in the discovery learning model. However, there were still some incomplete components, namely: 1) the contents of the concept of integrated natural sciences in teaching matrices; 2) delivery of assessment techniques to students at the beginning of learning; 3) discussing follow-up actions; 4) motivate students to encourage questions, predictions, and hypothesis.

Based on table 2, the lesson plans made by science teachers were categorized as good (80.03). In the description matrix, intense conformity through observation found no congruence between the availability of lesson plans made by science teachers and the learning process standards, especially in the component selection of learning resources, on indicators of conformity with the scientific approach and the characteristics of students. Also, the learning media selection components on indicators of conformity with scientific approaches and using varied learning methods to make students actively learn. Components of learning methods and learning scenarios on indicators of learning activities were designed to make students actively learn. While, in the closing component, it was the indicators to make conclusions of lessons, make assessments, give a reflection to the activities, provide feedback on the learning process and results, plan follow-up activities (remedies, enrichment, counseling, and assignments), and deliver lesson plans at the next meeting.

The factors that impressed the low achievement contained the background of science teachers who did not have the qualifications in natural science education but from Chemistry, Biology, and Physics. In planning integrated science, learning experiences difficulties (Susilowati, 2015). It caused the teacher to be less creative in choosing learning sources and media compatible with the scientific approach so that learning was designed not to make students active (Kamiludin & Suryaman, 2017), even students were reluctant to raise critical questions (Suparwoto, 2011). Winaryati, Suyata, and Sumarno (2013) confirmed that there was no compatibility between the lesson plan and the readiness of the teaching teacher, the readiness of the students, and the readiness of the equipment in junior high school.

Thus, science teachers were allowed to work closely with the primary teacher to start their experiences by designing learning, teaching practices, reflecting on them, and learning how to teach students in various ways and experiences in understanding scientific ideas.

Congruence on the Transaction Component

The component that was evaluated in this transaction was the science learning implementation activities. The following was the countenance matrix transaction component presented in table 3.

Table 3. Countenance Matrix Antecedent Component

Description Matrix		Judgment Matrix	
Intense	Observation	Standards	Judgments
Science teachers could learn following Permendikbud Number 65 of 2019 about Process Standards by applying the syntax of the discovery learning model.	The actual quality of science learning achievement was 73.68, categorized as enough. Not all science teachers had implemented learning according to the criteria set out in the Permendikbud process standard 65 of 2019.	Implementation of learning based on standard processes included: (1) Introduction: a) preparing students psychologically and physically; b) motivating the students to learn contextually; c) asking questions, giving a question to know students' previous knowledge; d) explaining the objectives of learning, or what they have to achieve during the learning process, and; e) present the scope of material and explain the description of activities. (2) core activities: a) using models, methods, media, and learning resources supported the students and subjects materials characteristics; b) selecting of	The implementation of science learning in junior high school in the discovery learning model does not follow the standard process. Science teachers still need to improve their professionalism through teacher working group activities and

<p>integrated and scientific thematic approaches with considering the characteristics of materials, and;</p> <p>c) conformity with the discovery learning model, including the stages: The teacher provides stimulation to arouse students' curiosity (stimulation), students formulate questions, predictions, and hypotheses (problem statements), students explore (data collection), students explore reasoning to process data and information (data processing); Students prove the truth of the hypothesis or prediction (verification), and students make conclusions</p> <p>(3) Closing activities: the teacher together with students, individually or in groups, examine to do an evaluation: a) All of the activities in the learning and its outcomes obtained to advance all things considered find, direct or indirect benefits, from the learning results that have occurred; b) giving feedback to the process and its results; c) carry out follow-up activities through relegating exercise, and; d) informing the plan of learning for the next meeting.</p>	<p>guidance from school supervisors.</p> <p>The stage that still needs to be improved is to show the ability of students to formulate questions, predictions, and hypotheses (problem statements) and prove them.</p>
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Table 3 explains that the actuality of learning achievement was in enough category (73.68). Based on the document study, it was found that there was no congruence between the practice of learning in class with the standard practice of learning processes that exist on purpose. This discrepancy was found in the introduction component, which was the indicator of challenging questioning based on multiple representations (Chusni & Saputro, 2020; Waldrip & Carolan, 2006), conveyed the benefits of learning materials, demonstrated something related to the theme, and checked the entry behavior of students (Wu, Chen, Battista, Watts, Willcutt, & Menon, 2017).

Likewise, in the core learning activities, not all science teachers carry out contextual learning that enables the growth of positive habits due to accompanying learning outcomes. At this stage, it also found difficulties in science teachers in applying a scientific learning approach (Grossmann & Wilde, 2019). Other findings on indicators of the ability to link material with other relevant knowledge, development of science and technology, and real-life, manage the discussion of learning materials and learning experiences appropriately, facilitate activities that contain components of exploration, elaboration, and confirmation as well as giving students questions to the reason (thinking processes logical and systematic) (In'am & Hajar, 2017). The discovery learning model's syntax findings showed that students still had difficulty formulating questions, predictions, and hypotheses (problem statement) (Ott, Carpenter, Hamilton, & LaCourse, 2018). These results indicated that the initial activities undertaken by teachers to provide stimulation to students had not been able to direct students to make hypotheses because teachers more often use learning media such as pictures, reading books, or nature without giving direction. Students' difficulty in formulating predictions and hypotheses was because teachers could not provide questions and statements that direct students in making provisional conjectures.

Then, in the closing activity, it is found that there was an incongruence in the indicator to reflect or make a summary by involving students, collecting work as portfolio material, and carrying out follow-up by giving direction to the next activity and enrichment task.

Inadequate implementation of science learning with the standard process started from the lesson plans, teachers, and learning supporting factors such as media and teaching methods (Kisworo, Ngabekti, & Indriyanti, 2017). The lesson plans made by natural science teachers were not optimal because of the teachers' limited ability to update the learning model, and the teacher was brutal to manage time. This impacts how teachers always form a memorizing culture compared to constructing students' critical thinking patterns (Chang, Li, Chen, & Chiu, 2015). The implementation of science learning could help students develop conceptual understanding and investigate (make questions, answer scientific questions), communicate and justify findings needed to develop productive citizens (Davis & Smithey, 2009). These were in line with the results of this research relating several teachers were still unable to implement effective learning using approaches, media, and learning resources. The lack of teacher's ability to facilitate interaction between students was not yet maximal in actively involving students in learning activities, including looking for extensive information about the material or topic being taught (Raharja & Retnowati, 2013). Thus, implementing learning in the classroom required science teachers who understand innovative design learning and could implement lesson plans in class (Wagner, Gollner, Helmke, Trautwein, & Ludtke, 2013).

Outcome Component

The component evaluated at this outcome stage was the science learning outcomes. The following was a component outcome matrix maintenance in table 4.

Table 4. Countenance Matrix Transaction Component

Description Matrix		Judgment Matrix	
Intense	Observation	Standards	Judgments
Student learning outcomes in science subjects met the minimum completeness criteria of 75.	The actual quality of science learning achievement was 71.16. It was found that there were still students who did not complete the daily tests, assignments, midterms, and final exams.	Students' scores on daily tests, assignments, midterms, end-of-semester exams and report cards met the minimum completeness criteria of 75.	Student learning outcomes did not meet the minimum completeness criteria. Science teachers should use authentic assessments that assess students' readiness, process, and learning outcomes in their entirety.

Table 4 explains no congruence between the science learning outcomes with minimal completeness criteria. It is shown by the actuality of students' learning outcomes of 71.16. A contributing factor to this discrepancy was the determination of the assessment process. Not all teachers mastered authentic assessment and the unavailability of assessment documents. The science learning assessment conducted by the teacher had not combined attitudes, knowledge, and skills through an authentic assessment process (Winaryati, Suyata, & Sumarno, 2013). Students' assessment process found no congruence between planning with the learning and assessment process (Raharja & Retnowati, 2013), as in the character and skills assessment process. It was known that the implementation of competency attitude and skills assessment was still an obstacle (Putri & Jumadi, 2017) because some teachers said that they had difficulty and took much time assessing the attitudes and skills of 30 students in each class (Setiadi, 2016). The assessment of skill aspects was carried out alternatively by checking in workgroups to make it easier to observe. This finding needed a concern that there must be consistency in planning, process, and assessment in learning. On the other hand, the limitations of teachers in developing holistic assessment tools make report cards less suitable, considering that there were three aspects of assessment that must be done.

Contingency

The relationship between antecedents with transactions, transactions with outcomes and antecedents, transactions and outcomes, both on intense and observation, all evaluation results were in a suitable category. Following the observation, some science teachers still did not understand how to prepare good lesson plans and carry out learning by the lesson plans made. Some science teachers were still duplicating lesson plans, which impacted the unsuccessful learning of teachers. It illustrated a contingency between natural sciences' planning, implementation, and learning outcomes. The lesson plans made by the teacher demonstrate the ability of the science teachers to plan was in the excellent category. It was influenced by some teachers who did not understand

preparing lesson plans so that learning designs were challenging to implement in the classroom, which affected learning was not optimal.

Inadequate learning planning could impact the implementation and assessment of student learning outcomes. The obstacles experienced by teachers in designing lesson plans with the discovery learning model still did not bring up a component to motivate students to formulate questions, predictions, and hypotheses (problem statement). This poor planning results in the implementation of teacher learning, rarely seen in guiding students to formulate predictions and hypotheses, which caused students to find them challenging. In discovery learning, it should present questions and activities that challenge students to utilize their prior knowledge to build and enhance student understanding (Kistner, Vollmeyer, Burns, & Kortenkamp, 2016). However, this can be improved by making learning more active (Diani, Irwandani, Al-Hijrah, Yetri, Fujiani, Hartati, & Umam, 2019; Rau, Kennedy, Oxtoby, Bollom, & Moore, 2017), focusing on students (Mahanal, Zubaidah, Sumiati, Sari, & Ismirawati, 2019; Supriyatno, Susilawati, & Ahdi, 2020), asking questions that attract curiosity (Nappi, 2017; Yang, 2017), and providing feedback on student thinking (Gentrup, Lorenz, Kristen, & Kogan, 2020; Pitt, Bearman, & Esterhazy, 2019).

The implementation of learning illustrated the ability of teachers to manage to learn not following the standard process. The factor influenced was the teachers' difficulties in planning learning, especially indicators causing active students to ask challenging questions in class. As a result, everything planned was challenging to implement in class. If teachers could compile a good lesson plan, then learning in the classroom impacted students learning outcomes. The science learning outcomes in the category illustrated the lesson plans, and the implementation of science learning was not yet entirely following the learning process standards. As a result, it was found that there were still students who did not complete the daily tests, midterm assessments, and end-of-semester assessments.

This discrepancy was also possible because teacher planning in the integrated science concept content was limited, so the concept content delivered to students was less developed. The choice of learning resources and media could help teachers motivate students to stimulate their curiosity. High curiosity could encourage students to formulate predictions and hypotheses and observe problems.

CONCLUSION

Based on the result of data analysis and discussion, it could be concluded that (1) natural science learning planning was good category (80.03), intense conformity with observation, in the description matrix found no conformity between the lesson plans made by science teachers with Permendikbud Number 65 of 2019 concerning learning process standards; (2) the implementation of natural science learning was in the enough category (73.68), which indicated no congruence between the implementation of learning in the discovery learning model in schools with the standard process of learning implementation; (3) student learning outcomes did not meet the minimum completeness

criteria with the actuality of achievement in the relatively enough category (71.16); and (4) there was a contingency between planning, implementation and science learning outcomes, learning planning with categories that were sufficient to cause the teacher to implement learning not in accordance with the standard process so that the learning outcomes of students had not met the minimum completeness criteria.

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