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Development of Learning Tools Using Discovery Learning Model Equipped with Science Marble Games to Improve Student's Critical Thinking Skills

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Abstract

This study aims to determine the characteristics and feasibility of the discovery learning model assisted by marble science games which was developed to improve students' critical thinking skills. This type of research is a research and development study with the ADDIE research model. The research subjects were students of class VIII SMP Kesatrian 1 Semarang. The research data were obtained from the feasibility test of the device developed by the experts as well as a questionnaire about the use of marble games as media science. The results of the due diligence analysis by the experts were stated to be very suitable for use with an average percentage of 83.88%. Questionnaire students' responses regarding the use of marble games science media were stated to be suitable for use with a percentage of 79.67%. Based on this it can be concluded that the development of discovery learning models assisted by science marble games is very feasible to be used to improve students' critical thinking skills.

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INTRODUCTION

Education is an interaction between educators and students to achieve predetermined educational goals. Educational goals can be achieved by carrying out the learning process. Education in Indonesia itself is regulated in Law Number 20 of 2003 concerning the National Education System.

One of the lessons carried out in order to achieve educational goals is science learning. Science learning is complex, so it tends to be oriented towards science products, this is shown by theoretical learning using conventional models where learning only occurs in one-way communication (Budiharti, 2015). Two-way communication between teachers and students can run if the organization and delivery of material is in accordance with the mental readiness of students and is equipped with learning tools that support students (Rahmatika, 2016). Research by Mustami & Dirawan, (2017) states that teachers are required to always be active and creative in developing methods used for the success of the learning process as well as the existence of important learning tools to support the science learning process. The learning tools developed are able to support the achievement of students' critical thinking skills by using innovative models.

The 2013 curriculum learning context refers to learning with a scientific approach, where learning objectives are achieved using an innovative model to facilitate students to be actively involved. Using the 2013 curriculum, students are able to develop critical thinking skills and are not only oriented towards the use of teacher-centered learning and materials. In line with Rahayu (2016) that critical thinking skills can be developed with learning that places students as individuals who have superior seeds and require activities to develop their knowledge.

One learning model to improve critical thinking skills is a discovery learning model. Discovery learning with a scientific approach is able to improve critical thinking and problem solving skills and gain knowledge of concepts for students which have an impact on improving learning outcomes (Nugrahaeni, et al., 2017). Research conducted by Darma, et al (2014) states that learning by involving games is a method that has an influence on student learning outcomes. Hoesnan (2014) states that the implementation of the discovery learning model needs learning tools that focus the activities of students in an active way of learning and students are able to find, investigate the concepts and principles themselves so that it results in long-lasting results.

Based on observations at SMP Kesatrian 1 Semarang which is located at Jl. Arteri Seokarno-Hatta, Palebon, Kec. Pedurungan, Semarang City, Central Java, has several obstacles, namely the critical thinking ability of students has not been directed optimally because the questions in the textbook do not show questions that have critical thinking indicators. Evidenced by the value of daily science tests below the KKM value (minimum completeness criteria), namely 70. There are ± 60.71% of students who have IPA scores (programmed daily assessments) in the odd semester of science subjects below the KKM. Based on classroom observations, students tend to be active when there is a simple game to support learning.

Based on these results, it is necessary to develop learning tools with innovative models that are able to improve students' critical thinking skills. Discovery learning models can improve students' critical thinking skills. The learning tools developed include syllabus, rpp, ldpd, and evaluation questions. The syllabus, rpp, and ldpd were developed by paying attention to the syntax of the discovery learning model. The syntax in the discovery learning model according to Astuti (2015) includes: (1) stimulating, (2) problem statement, (3) data collection, (4) data processing, (5) verification, and (6) generalization.

The evaluation questions developed have indicators of critical thinking skills, the indicators used refer to Ennis (2011) including: (1) giving a simple explanation, (2) building basic skills, (3) concluding, (4) making further explanations, and (5) implementing strategies and tactics. The learning device being developed is also assisted by a media game, namely science marble games. This game is a modified game of the Bangtan Marble game. Science marble games are generally similar to monopoly, except that the rules of the game are simplified according to the rules of the game in marble bangtan.

Research on the development of discovery learning models assisted by science marble games to improve critical thinking skills is carried out to answer the problem formulation, namely (1) how are the characteristics of the discovery learning model assisted by science marble games developed? and (2) how is the feasibility of the discovery learning model assisted by science marble games developed?

METHODS

This research is a research and develop-

ment study. The development model used is the ADDIE (analyze-design-development-implement-evaluate) model, but in this study it is only used to ADD (analyze-design-development).

The research subjects were VIII grade students of SMP Kesatrian 1 Semarang. The sampling technique in this study is cluster random sampling, which is sampling for data sources based on predetermined population areas (Sugiyono, 2018).

The development procedure in this study with the ADD development method can be seen in Table 1.

Table 1. The Development Procedure

Stages	Type of Activity
Analyze	Analysis of larning tools Analysis of learning models (learning in class) Character analysis of students
Design	Designing learning tools
Development	Product development Expert validation

The method in this development research is the questionnaire method and the method of documentation. This questionnaire method is in the form of a feasibility assessment questionnaire by experts. The experts referred to are experts in learning tools (syllabus and lesson plan), media experts, and material experts. Another questionnaire used is a questionnaire for students' responses regarding the use of marble games as media science. The two questionnaires were distributed online. Questionnaire sheets for students' responses regarding the use of science marble games, begins with the feasibility test of science marble games by media experts, then science marble games are made videos then uploaded to YouTube, and to fill out the questionnaire, a google form is used which is distributed to students. Data collection methods in this development research can be seen in Table 2.

The data analysis for the feasibility test of the learning devices developed and the questionnaire results of students' responses regarding the use of science marble games are the same. The feasibility test is measured using construct validity, namely testing the instrument with consideration of the opinions of experts (judgment expert) (Sugiyono, 2018). The experts are lecturers in the Department of Integrated Science and teachers of Science subjects. The expert fills out the assessment sheet by giving a score according to the rubric, namely the score range 1 to 4.The expert assessment sheet instrument and student responses are analyzed by the formula:

P =x100%

Information:

P = response analysis

f = score achieved

N = maximum total score

(Sudijono, 2010: 43)

The results of the percentage of feasibility test data and responses are then converted into the assessment criteria based on Table 3.

Table 3. The Assessment Criteria

Kriteria Validitas	Level of Validity
81.25% score 100%	Very worth using
62.50 score 81.25%	Worth using
43.75 score 62.50%	Quite worth using
25.00% score 43.75%	Less suitable using

(Sugiyono, 2015)

Based on the expert assessment sheets and student response questionnaires, the discovery learning model assisted by science marble games is said to be feasible to collect data if the percentage of the assessment score is> 55.1%. If the percentage of the assessment score is ≤ 55%, then the product needs to be revised again.

RESULTS AND DISCUSSION

The results of this study are in the form of discovery learning model assisted by science marble games which is declared very suitable for use by experts. The learning tools developed were syllabus, lesson plan, media science marble games, evaluation questions, and worksheet. The learning tools developed have different characteristics from learning tools in general.

Syllabus

The syllabus developed is almost the same

Table 2. Data Collection Methods

Type od data	Methods	Instrument	Time of collection
Feasibility of learning devices	Non Test	questionnaire (expert validation instrument)	Prior to product trial
Students responses	Non Test	Questionnaire	Small scale trial

as the syllabus in general, it's just that the learning activities listed in the syllabus contain 5 M (observing, asking, trying, analyzing, and communicating). Learning activities are also adjusted to the syntax in the discovery learning model.

The syllabus contains (1) educational units, (2) classes and semesters, (3) subject matter, where the main material is global warming, namely grade VII even semester material, (4) core competencies. The syllabus contains a table about the lesson plan for the duration of the material. The syllabus table contains, as follows: (1) Basic competencies, containing four points, namely 1.1 and 2.1, where these two basic competencies are integrated in learning through indirect teaching, while for basic competencies 3.9 and 4.9 are implemented through learning activities; (2) Indicators, indicators used are adjusted to basic competencies 3.9 and 4.9. There are six indicators used including: (1) explaining the definition of the greenhouse effect, (2) explaining the meaning of global warming, (3) analyzing the process of global warming, (4) analyzing the impact of global warming, (5) describing efforts to combat global warming , and (6) producing a poster on the prevention of global warming; (3) Main material; (4) Learning activities; (5) Time allocation, one lesson with duration of 40 minutes, for global warming material is used 7x40 minutes; (6) Book sources, and (7) The media used.

The overall development of the syllabus includes accountable materials and activities.

Lesson Plan

The lesson plan is more complex than the syllabus. The lesson plan at the top contains (1) educational units, (2) subjects, (3) classes / semesters, (4) main subjects, (5) time allocation. The RPP contains the following: Core competencies, Basic competence, Indicators, The learning objectives, in this learning objective, have an ABCD format, namely A for Audience, B for Behavior, C for Condition, and D for Degree. Material, in the lesson plan the material is more clarified. Approaches, methods, and models. The learning approach is carried out scientifically, the method used is discussion, and the model used is the discovery learning model. Media, tools / materials, and learning resources Learning activities, this activity is divided into four meetings. Learning activities are displayed in a table containing learning steps (introduction, core and closing activities), continuous discovery learning syntax with 5M steps, and time allocation. Assessment.

The lesson plan development still pays attention to core competencies, basic competencies, and indicators, learning objectives, materials, learning activities as well as assessments and learning resources.

Media

The media used during the learning process were video, PPT, and science marble games. The video was played during the observing process, the PPT was used during the discussion, and the science marble games were used during the discussion process. Media science marble games can be seen in Figure 1.

Figure 1. *Science marble games*

Student Discussion Sheet

Student discussion sheet is designed as attractive as possible by paying attention to images and colors. Student discussion sheet contains topics, learning objectives, basic competencies, instructions and learning activities that must be carried out by students. Learning activities in student discussion sheet refer to the discovery learning model syntax.

Evaluation questions (pretest and posttest)

The questions are in the form of reasoned multiple choice, arranged by taking into account the learning indicators and indicators of critical thinking skills. This question is to measure the increase in students' critical thinking skills in knowledge.

Learning Device Feasibility Test Results

Experts to test the feasibility of learning tools tailored to their expert fields. Each learning device was tested for feasibility with 5 experts, namely 3 from the science department lecturer and 2 from the science teacher.

The results of the due diligence can be seen in the Figure.

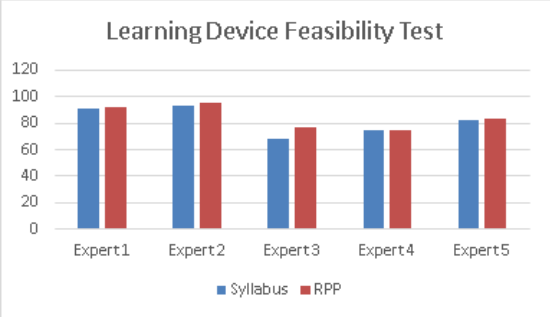

Figure 1. Learning Device Feasibility Test Results

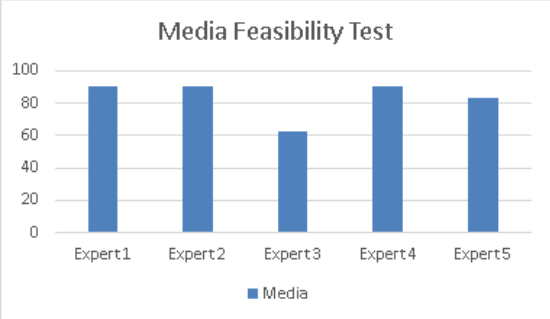

Figure 2. Media Feasibility Test Result

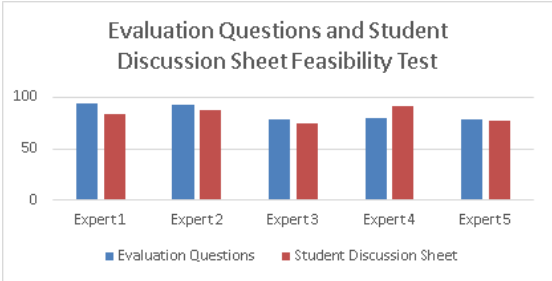

Figure 3. Evaluation Questions and Student Discussion Sheet Feasibility Test Result

The assessment criteria are based on Sugiyono (2015), the criteria are very feasible to use when the score is in the range 81.25% to 100%, then for the appropriate criteria, the score is in the range of 62.50% to 81.25%. Based on the graph above, it was found that all learning device experts stated that the learning tools, namely the syllabus and lesson plans developed, obtained very suitable criteria for use. Four out of five media experts stated that the media science marble games developed were declared very suitable for use, while expert 3 stated that the media used was

Table 4. Expert Input and Revision Results

Products Developed	Input	Revision
Syllabus	Incompatible with the RPP	Adjust syllabus with RPP
	Time allocation is adjusted to the real conditions	Time allocation adjusts to real conditions
	Specifications of discussion activities at each meeting	Discussion activities are differentiated by using discussion sheet
	Plus a column for the media used	Adding the media fields used
Lesson Plan	The material is made clearer	Explain the material according to the learning indicators used
	Questions are directed towards the problem statement	Directing students to make statements towards the problem statement
	Making an assessment rubric	Create an assessment rubric
Science marble games	Clarify the rules of the game	The rules of the game are clarified
Evaluation questions	About not thinking critically	Fix the questions to match the indicators of critical thinking
	Layout charts, tables and figures tidied up	Tidy up the layout of charts, tables and figures
	Out of sync graphs and answers	Synchronize graphics and Figures
Student discussion sheet	The video is not clear	Describes the video to be shown
	Clarify the steps for creating the poster	Clarify the steps for making a poster

feasible. The five material experts (questions and discussion sheet) stated that the questions and discussion sheet developed were very suitable for use.

The assessment of the learning tools developed cannot be separated from some input by experts. Input from experts is used as a consideration for making revisions. The expert's consideration also needs to be considered for the perfection of the learning tools being developed. Input by experts can be seen in Table 4.

The results of the feasibility test for the media are then used to make a questionnaire about the use of media by students. The media is distributed online by making videos and then uploading them to YouTube, then students can watch the video and fill out a questionnaire via Google Form. The results of the questionnaire responses regarding the use of marble games as media science can be seen in Table 5.

Table 5. Student Response Questionnaire Results

Pernyataan (%)																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
88.89	85.56	87.78	86.67	86.67	83.33	83.33	37.78	86.67	82.22	85.56	82.22	81.11	85.56	78.89	80	86.67	82.22	40	82.22

Based on the table above, 18 students filled out the response questionnaire. The development of learning tools with the discovery learning model has the advantage of stimulating curiosity from students, motivating them to continue activities that are ultimately able to solve problems (Roosyanti, 2017). In line with Khorunnisa and Siswono (2013) states that the use of discovery learning in learning activities with learning tools developed can be said to be effective.

The syllabus is one of the basic guidelines for making other learning tools, namely the learning implementation plan, while the lesson plan is a face-to-face learning activity for one or more meetings. The syllabus and lesson plans were developed because one of the problems in the preparation of the tools was the monotonous syllabus and the absence of innovation and evaluation every year (Saleh, 2019).

The learning process in order to help students understand the material must use the media, this is because the material presented is not too verbalistic. Media selection must also be selected in accordance with the material presented. Research conducted by Istiqal (2018) states that media in learning is useful as a means of smoothing the interaction process between teachers and students.

Learning tools developed are assisted by media and evaluation questions. The development of pretest and posttest questions as evaluation items was used to measure critical thinking skills. The development of multiple choice questions is effective for measuring critical thinking skills (Aripin, 2018). The questions were made to indicate the ability to think critically. Critical thinking is one of the HOTS categories and one way to measure critical thinking skills is by choosing (Fanani, 2013). Learning is also assisted by the existence of student discussion sheets (LDPD). The steps in the discussion activities are adjusted to the RPP. According to Susanti etc (2016) students can collaborate by carrying out learning activities and applying scientific attitudes in the discussion steps carried out.

CONCLUSION

Based on the research results, the following conclusions can be obtained: The learning device developed has a special character, namely by using the discovery learning model with the help of media science marble games. The media science marble games have special characters where no one has yet developed them so that they become innovative media for learning science in particular. Feasibility for the developed learning device gets very suitable criteria for use.

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