Development of Inkuiri Model Learning Tools Guided to Improve Concept Mastery Learner Physics

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Abstract: This study aims to determine the validity, practicality, and effectiveness of guided inquiry learning models to improve students' mastery of physics concepts. This type of research includes research and development of Research and Development (RnD) with the research design used is the 4D model which consists of define, design, develop and disseminate. Products developed in the form of a syllabus, lesson plans, student worksheets, test instruments in the form of questions, and learning videos. The product validity was analyzed by determining the value of the content validator index (CVI) through a questionnaire. Practicality is obtained from student response questionnaires and learning implementation sheets. Furthermore, the effectiveness is obtained from a limited trial to obtain the N-gain test value. The results of the study based on the CVI average value assessment of expert validators and practitioner validators approached one with the very good category. The reliability of learning devices above 75% indicates that all aspects assessed are included in the reliable category. The results of the response of students obtained <80% with practical criteria and the average implementation of learning for three meetings was 87.7% with very practical criteria. The N-gain result of the concept mastery is 0.63 in the medium category. Based on these results, it can be concluded that guided inquiry learning tools to improve students' mastery of physics concepts are valid, practical, and effectively used in learning.

Keywords: Development; Learning Tools; Guided Inquiry Model; Concept Mastery.

Introduction

Science and technology in the 21st century are developing quite rapidly and affecting all areas of life, especially in the field of education. According to Saavedra & Opfer (2012) there are five abilities that students in the 21st century must have, namely, creativity and innovation, critical thinking, problem solving, decision making, and metacognitive. According to Trilling & Fadel (2009), learning content is expected to be able to meet 21st century skills, namely learning and innovation skills including mastery of diverse knowledge and skills, learning and innovation, critical thinking and problem solving, communication and collaboration, as well as creativity and innovation. Mastery of these skills enables mastery of other skills and competencies necessary for a successful life in the 21st century. Based on these opinions, it is very important for students to have good mastery of concepts.

Mastery of concepts is the ability of students to accept and understand the concepts, theories and principles of physics appropriately and can be applied in everyday life. Concept mastery is an understanding

using concepts, rules and principles. Mastery of concepts in the development of learning tools is needed because it is the most basic thing in solving physics problems.

Based on the results of interview observations of one of the teachers at SMAN 1 Gunungsari, physics learning is still dominated by the discussion, question and answer and lecture methods and the learning tools available and used by teachers from year to year are almost the same so that they only support teachers to apply the discussion, question and answer method and the dominant lecture during physics learning in class. This method is considered less effective because it makes students passive, communication only goes one way from teacher to student. In addition, only focusing on transferring values according to the demands of the 2013 Curriculum has not been achieved. Students only solve problems in physics without knowing the application in everyday life. As a result, students do not like physics because they think physics is difficult, boring and less applicative.

The problems that occur in schools are not only like that, recently the world has been shocked by the emergence of a virus called the corona virus or better known as covid-19 (Corona Virus Diseases 19). This virus has created policies that have had a huge impact in the economic, social, tourism and especially in the field of education. The government's decision to move the learning process from school to home has made educational institutions spin the brains in solving existing problems. This shift in learning methods forces various parties to take advantage of technology as an alternative media for implementing online learning.

Learning that is carried out online makes students feel bored because they cannot interact directly with teachers or friends. Based on the results of an interview with one of the teachers at SMAN 1 Gunungsari, online learning is usually done through the google classroom application, but some students respond directly to learning due to limited quotas and networks. This causes some students have difficulty understanding the material being taught. The method used in online teaching is the assignment method which is strengthened by providing material via WhatsApp. Even so, teachers still find it difficult to monitor students in learning the material provided.

Moving on from these problems, it is necessary to have an effort and learning innovation that helps students to master the concepts in learning activities. Online learning activities must be carried out effectively and innovatively so that teachers can easily convey material that can hone students' thinking skills. Therefore, it is necessary to conduct research on the development of learning tools that teachers can use in carrying out learning.

Research on the development of learning tools that will be carried out is based on online learning models, fostering mastery of concepts that can create a pleasant learning environment, one of which is the guided inquiry learning model. This learning model involves students directly so that students are able to understand physics concepts appropriately in everyday life.

The guided inquiry learning model is a learning model that emphasizes the critical thinking process to seek and find answers to a question in question. It is hoped that by seeking and finding their own knowledge students will better understand the concepts through experiments in the material. Piaget (in Mulyasa, 2006) argues that the guided inquiry model is a model that will prepare students in situations to carry out their own experiments widely in order to see what happens, using the guided inquiry learning model students will be able to master the concept of physics because in its application the model Guided inquiry requires students to find their own answers to the questions at hand.

The inquiry learning model is one of the observation-based learning models. Nurdyansyah & Fahyuni (2016) said that the inquiry model is learning that involves learners in finding and understanding knowledge through investigations that begin with observation, asking questions, planning and experimenting, collecting data, analyzing data, making conclusions, and communicating the results.

Basuki, et al (2015) states that experience from facts of a theory is obtained through the use of an inquiry model. However, considering that students are not accustomed to conducting inquiry activities, students at the high school level can use the guided inquiry model. In the guided inquiry learning model, the teacher provides guidance and instructions for students during learning activities. According to (Susilawati, et al, 2019) the role of the teacher as a facilitator provides greater opportunities for students to build their own conceptual skills and understanding. Furthermore, Sumiyarti, et al, (2019) states that guided inquiry-based learning provides direct experience by looking for facts so that students can learn to look for a theory and practice their skills.

The success in the learning process is strongly influenced by the learning tools used, for that it is necessary to develop learning tools. The transformation of the development of learning tools is necessary and good for students. The learning tools that will be developed are learning tools based on guided inquiry models. The form of learning tools developed is still the same as learning tools in general, but in this study there are several differences which according to researchers will be its own advantages. The first is the syllabus,

researchers compile learning activities that direct students to play a more active role in learning activities. The second is the lesson plans, the researcher transforms the guided inquiry learning syntax in it. The third is student worksheet, the researcher arranges it according to the learning syntax used.

There are several supporting previous studies. The first study was a development research conducted by Dewi et al (2013) entitled Development of Integrated Science Tools with Guided Inquiry Settings to Improve Students' Concept Understanding and Scientific Performance. This research resulted in a guided inquiry learning model, increased students 'scientific work and students' responses to the device and the implementation of guided inquiry learning activities generally gave a positive response. Based on this explanation, it is necessary to do further research on "Development of Guided Inquiry Model Learning Tools to Improve Students' Mastery of Physics Concepts"

Method

Types of research

This study used the Research and Development research method with the research model developed was 4D Models which consisted of defining (Define), designing (Desing), developing (Developing), and spreading (Disseminate). This research is intended to develop a guided inquiry learning model to improve students' mastery of physics concepts.

This development research was carried out at SMAN 1 Gunungsari odd semester in October 2020. The subjects of this study were students of class XI at SMAN 1 Gunungsari. The type of data in the development of guided inquiry model learning tools to improve students' mastery of physics concepts is qualitative and quantitative data. Qualitative data is obtained from the results of validation in the form of suggestions from expert validators and practitioners, in the form of comments or suggestions for revised material. While quantitative data were obtained from the results of validation by expert validators, observations of the implementation of learning and student response data.

Data Collecting Techniques

The validity data collection technique was carried out by using expert tests where the experts were three physics lecturers and three practicing teachers. Assessment is done through expert validation sheets with a scale of 1 - 5 where 1 means not good, 2 means not good, 3 means good enough, 4 means good and 5 means very good. Then the practicality data were obtained from the responses of teachers and students,

and the effectiveness data were obtained from the results of the N-gain test.

Data analysis technique
1. Validity Data Analysis

Before being used for a limited test, learning tools such as syllabus, lesson plans, student worksheet, test instruments, and learning videos were validated for their eligibility by 3 expert lecturers and 3 practitioners. The validity of the learning device is calculated using the Content Validity Ratio (CVR) and the Content Validity Index (CVI). How to calculate the CVR value is by using equation (1).
Validity Ratio (CVR) formula:

$$CVR = \frac{Ne - \frac{N}{2}}{\frac{N}{2}} \tag{1}$$

(Lawse, 1975)

Information:
N_e = number of validators who agreed
N = total number of validators
Furthermore, the CVI is also calculated which is an indication of the validity of the test content. CVI is the average of the CVR value of all items

$$CVI = \frac{the\ total\ CVR}{number\ of\ items} \tag{2}$$

The category of CVR and CVI calculation results ranges from the CVR and CVI values to -1 <0 <1. This figure is categorized as follows:
-1 <x <0 = not good
0 = good
0 <x <1 = very good

The reliability in this study uses the Borich method, which is known as the Percentage Agreement (PA), which is the percentage agreement between assessors which is a percentage of the value conformity between the first assessor and the second assessor. Percentage Agreement (PA) can be formulated in equation (3).

$$PA = \left(1 - \frac{A - B}{A + B}\right) 100\% \tag{3}$$

Information:
A = Greater score
B = smaller score

The device is said to be reliable if the percentage value of the agreement is more or equal to 75%. If less than 75% is generated, it must be tested for clarity and approval from observers (Borich, 1994).

2. Practicality Data Analysis

Data on the practicality of learning devices will be obtained from students' responses and observation sheets of learning implementation by the observer, and

then will be analyzed to determine the average percentage with the following equation

$$\%average = \frac{\text{Sum of scores from ratings}}{\text{Sum of maximum scores}} x100\% \quad (4)$$

After being analyzed, the data will then be interpreted based on practicality criteria. The level of practicality of the instrument is determined according to the following table.

Table 1. Practicality Criteria

No	Value Range Percentage	Level of Practicality
1	0-20	Very impractical
2	21-40	Less practical
3	41-60	Quite practical
4	61-80	Practical
5	81-100	Very practical

(Arikunto, 2010)

The implementation of learning or the practicality of the guided inquiry learning model is also seen based on the responses of teachers and lecturers obtained through distributing questionnaires after the learning process takes place. The questionnaire instrument uses a Likert scale with the following score criteria.

Table 2. Scoring Questionnaire Instruments

No	Statement	
	Answer	Score
1	Disagree (TS)	1
2	Disagree (KS)	2
3	Simply Agree (CS)	3
4	Agree (S)	4
5	Strongly Agree (SS)	5

3. Effectiveness Data Analysis

Analysis of the effectiveness of the tool consists of an analysis of increasing mastery of concepts and the ability to think creatively. To analyze the increase will be used analysis of the normalized N-gain value. This analysis aims to determine the increase in the pretest and posttest scores. According to Hake (1998), the normalized gain (N-gain) calculation is with the following formula.

$$N - gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} x \, 100\% \quad (5)$$

Information:
Spost: The final posttest score
Spre: The final pretest score
With the following categories of N-gain gain.

Table 3. Criteria for N-gain

No.	Interval	Criteria
1	g > 0,70	High
2	0,30 ≤ g ≤ 0,70	Moderate
3	g < 0,30	Low

(Hake, 1998)

Result and Discussion

Defining aims to obtain information about the characteristics of students, problems that arise during learning, learning methods used by teachers, and other supporting media as well as assessing the curriculum used. In the early stages, the learning strategy during Covid-19, namely from face-to-face learning to online or online learning through the Google classroom application as a place for attendance, delivering material, assigning assignments, and collecting assignments and WhatsApp as a place to exchange information between teachers with students. Even so, teachers still find it difficult to monitor students in learning the material provided. Students feel bored and limited quotas cause some students not to carry out learning properly. In the task analysis, the curriculum used is the 2013 curriculum at KD 3.11 and 4.11 which then determines the competency achievement indicators. In concept analysis, the material used is optical tools. Furthermore, the learning objectives specifications are determined.

The design stage is the stage of designing the initial draft of the learning tools that will be used in learning the Optical Equipment material. The resulting draft was in the form of a syllabus, lesson plans, student worksheet, question instruments, and learning videos.

The development stage is the stage to produce a product development which is carried out through several steps, in this case, namely the assessment of expert and practitioner validators, product revisions and limited trials of 15 students. The following is a summary of the results of the product validity analysis shown in Table 4 and 5.

Tabel 4. Summary of Results of Product Validity Analysis by Expert Validators

No	Quality	CVI	Device
1	Syllabus	0,72	Very good
2	Lesson Plans	0.87	Very good
3	Student Worksheet	0,94	Very good
4	Quation Instruments	0,90	Very good
6	Learning Videos	0,81	Very good

Tabel 5. Summary of the Results of Product Validity Analysis by Practitioner Validators

No	Quality	CVI	Device
1	Syllabus	1	Very Good
2	Lesson Plans	1	Very Good
3	Student Worksheet	1	Very Good
4	Quation Instruments	1	Very Good
6	Learning Videos	1	Very Good

The reliability in this study uses the Borich method, which is known as the Percentage Agreement (PA), which is the percentage agreement between assessors which is a percentage of the value suitability between the appraisers. The Borich method is used for 2 validators so that the analysis is done by combining 2 validators, so that there are 15 combinations for the validator pairs. The Percentage Agreement (PA) value of each device is taken as the average value of the validator combination. The reliability of the product developed can be seen in Tables 6 and 7.

Tabel 6. Table 6 Summary of Product Reliability Analysis Results by Expert Validators

No	Product	Average PA	Category
1	Syllabus	79,98 %	Reliable
2	Lesson Plans	82, 06%	Reliable
3	Student Worksheet	88,13%	Reliable
4	Quation Instruments	86,64%	Reliable
5	Learning Videos	85, 03%	Reliable

Table 7. Summary of the Results of Product Reliability Analysis by Practitioner Validators

No	Product	Average PA	Category
1	Syllabus	96,67%	Reliable
2	Lesson Plans	95,57%	Reliable
3	Student Worksheet	96,91%	Reliable
4	Quation Instruments	92,59%	Reliable
5	Learning Videos	93,94%	Reliable

Analysis of the practicality of learning tools aims to determine the practicality of learning tools developed to be applied in the learning process. In determining the practicality, data obtained from students on the learning tools developed are as follows.

Table 8. Results of Practicality Analysis of Learning Devices by Students

No	Product	Percentage	Category
1	How to teach teachers	81,82%	Very practical
2	Student Worksheet	71,37%	practical

Then the practicality data obtained from the implementation of learning when a limited trial was carried out on the learning device was as follows.

Table 9 Results of Learning Implementation Analysis

No	Observer	Average Score	Category
1	I	87.05	Very Practical
2	II	87.83	Very Practical
3	III	88.23	Very Practical

The effectiveness of the learning tools is known from the data analysis on the improvement of concept mastery. Based on the analysis that has been done, the overall standard gain value is 0.63. From these results, based on the interpretation of the standard gain value, the increased mastery of the subject's physics concept is in the medium category. As below, Table 4 summarizes the results of the analysis of concept mastery using the gain standard.

Table 10. Results of PK Category Analysis through N-gain Calculation

N-gain Score (g)	Category	Number of Students	Percentage
0,70 < g < 1,00	High	6	35%
0,30 < g < 0,70	Moderate	11	65%
0,0 < g < 0,30	Low	0	0%

The dissemination stage is the final stage of this research development stage. The purpose of this stage is the dissemination of research products. As for its implementation, the articles from this development research are published online in e-journals.

The purpose of this research is to produce a guided inquiry learning model on materials of optical tools that are valid, effective, and practical. This study uses the Research and Development (R&D) research method with the research model developed is 4D Models consisting of the defining, design, development and dissemination stages.

The validity, effectiveness and practicality of the guided inquiry model learning tool can be seen based on the validator's assessment, student response questionnaires, observations of learning implementation and the results of the N-gain increase analysis.

The validity of the syllabus can be determined from the results of validation by expert validators and practitioner validators. The validation analysis of the six validators was calculated using CVR and CVI. Based on the analysis, the CVR and CVI values obtained by expert validators and practitioners were 0.72 and 1 so they were categorized as very valid. Meanwhile, the reliability of the syllabus is calculated using Percentage Agreement analysis. A device is said to be reliable if the Percentage Agreement is above 75% or equal to 75%. The value of the Percentage Agreement on the syllabus by expert validators and practitioners is 79.98% and 96.67%, this indicates that the syllabus is declared reliable.

The validity of the lesson plan can be determined from the results of validation by expert validators and practitioners. Based on the results of the analysis, the CVI values were 0.87 and 1 respectively so that they were categorized as very valid. Meanwhile, the reliability of the lesson plans is calculated using Percentage Agreement analysis. A device is said to be

reliable if the Percentage Agreement is above 75% or equal to 75%. The value of Percentage Agreement on lesson plans by expert validators and practitioners is 82.06% and 95.57%, this indicates that the lesson plans is declared reliable.

The validity of the student worksheet can be determined from the results of validation by expert validators and practitioners. Based on the results of the analysis, the CVI values were 0.94 and 1 respectively so that they were categorized as very valid. Meanwhile, the reliability of student worksheet is calculated using Percentage Agreement analysis. A device is said to be reliable if the Percentage Agreement is above 75% or equal to 75%. The value of the Percentage Agreement on student worksheet by expert validators and practitioners is 88.13% and 96.91%, this indicates that student worksheet is declared reliable.

The validity of the question instruments can be determined from the results of validation by expert validators and practitioners. Based on the results of the analysis, the CVI values were 0.90 and 1 respectively, so they were categorized as very valid. Meanwhile, the reliability of the question instrument was calculated using Percentage Agreement analysis. A device is said to be reliable if the Percentage Agreement is above 75% or equal to 75%. The Percentage Agreement value on the question instrument by expert validators and practitioners was 86.64% and 92.59%, this indicates that the question instrument was declared reliable.

The validity of the instructional videos can be determined from the results of validation by expert validators and practitioners. Based on the results of the analysis, the CVI values were 0.81 and 1 respectively, so that they were categorized as very valid. Meanwhile, the reliability of the learning videos is calculated using Percentage Agreement analysis. A device is said to be reliable if the Percentage Agreement is above 75% or equal to 75%. The value of the Percentage Agreement on the learning videos by expert validators and practitioners is 85.03% and 93.94%, this indicates that the learning videos are declared reliable.

The feasibility of the syllabus is due to the systematic preparation of the syllabus and contains components according to the applicable curriculum. Based on PP 32 of 2013 article 1 states that the planning of the learning process includes a syllabus and a learning implementation plan that contains at least learning objectives, teaching materials, learning methods, learning resources and assessment of learning outcomes. The syllabus created by the researcher already contains the components in question according to the syntax of the guided inquiry model. This is also supported by Mulyono *at al* (2013) who has developed a learning tool in the form of a syllabus with an average validity score of 97.73% in a very feasible category

because it has met the systematic writing of the syllabus based on the 2013 curriculum.

The results of the analysis of the practicality of learning devices were obtained from student response questionnaires and observation sheets of learning implementation. The results of the student response analysis obtained an average of 76.59 which means practical. Then the analysis of the implementation of learning obtained an average of 87.80 with the very practical category. This shows that the guided inquiry learning model to improve mastery of practical concepts used in learning.

This shows that the learning process uses media in the form of instructional videos and several other media. The students' responses stated that learning with the help of videos would be easier and more practical in online learning because they could see first hand the experiments being carried out. However, students revealed that learning would be more exciting if the experiment could be done directly. The presence of instructional videos can make it easier for students to understand the concepts in the material of opti tools and can make it easier for teachers to convey these concepts.

The results of the analysis of the pretest and posttest using N-gain obtained an average of 0.63, which means that the difference between the increase in pretest and postest learning outcomes is in the medium category.

The determination of the category is based on Hake (1998) where the N-gain score, which ranges from 0.3 to 0.7, is in the moderate category. Furthermore, a category analysis of concept mastery was also carried out to classify students who experienced an increase in mastery of high, medium, and low concepts. The results of the data analysis showed that there were 6 students who experienced an increase in high PK, 11 students with moderate categories, and no students with low categories. Based on the results of this analysis, it can be seen that the guided inquiry learning model is effective for increasing students' mastery of concepts.

Conclusion

Based on the results of the research data analysis, the following conclusions were obtained: (1) Guided inquiry model learning tools in the form of syllabus, lesson plans, student worksheets and learning videos were developed based on the steps of guided inquiry model learning. Also developed test questions that are arranged based on the objectives to be achieved and based on the level of the cognitive domain, namely C1 to C6; (2) Guided inquiry model learning tools on the subject matter of Optical Tools which include syllabus,

lesson plans, student worksheets, question instruments and learning videos developed are of very good quality and reliable so they are feasible to be applied in online learning to improve students' mastery of physics concepts.; (3) Guided inquiry model learning tools on the subject matter of Optical Tools which include syllabus, lesson plans, student worksheets, question instruments and learning videos developed have very good quality so that they are practically used in online learning to improve students' mastery of physics concepts; (4) Physics learning tools based on guided inquiry models on the subject matter of Optical Tools are effectively used to improve students' mastery of physics concepts in online learning. This can be seen from the limited test results which show that learning outcomes have increased with a standard gain value of 0.63.

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