American Journal of Educational Research, 2020, Vol. 8, No. 12, 938-945
Available online at http://pubs.sciepub.com/education/8/12/7
Published by Science and Education Publishing
DOI:10.12691/education-8-12-7

Development of Discovery Learning Tools

Afwanil Huda Nasution*, Edy Surya, Mariani Mariani

Post Graduate Program in Mathematics Education, State University of Medan, Indonesia
*Corresponding author: afwanilhuda897@gmail.com

Received November 15, 2020; Revised December 16, 2020; Accepted December 23, 2020

Abstract The purpose of this research is to find a solution to the problems placed by SMA Negeri 1 Binjai in the form of; low mathematics learning outcomes, do not like mathematics, and 47% of students who exceeded graduation scores. Researchers try to provide a solution in the form of developing discovery learning tools. These learning tools include; RPP, student books (BS), teacher books (BG), and learning activities (LAS). The learning tools are structured based on the principles of the discovery learning model. The development model used in this study is Dick and Carrey, with the research subjects of SMA Negeri 1 Binjai students connecting 60 students, as well as on geometric transformation material. In the development process, two trials of learning devices were carried out with the aim of seeing the validity (expert validation), practicality (class validation and management) and effectiveness (classical completeness, achievement of learning objectives, learning time and student response) as a condition for quality development outcomes. Based on the results of the study, it was found that the diskpvery learning device met the criteria of validity, practicality and effectiveness.

Keywords: *learning tools, discovery learning, development research, mathematics learning outcomes*

Cite This Article: Afwanil Huda Nasution, Edy Surya, and Mariani Mariani, "Development of Discovery Learning Tools." *American Journal of Educational Research*, vol. 8, no. 12 (2020): 938-945. doi: 10.12691/education-8-12-7.

1. Introduction

Based on the results of interviews with mathematics teachers, it was found that 60% of students did not like learning mathematics. Mathematics is still a boring and scary subject for students. From the interview, it was also found that students' mathematics learning outcomes were very low. Only 47% of the 42 students whose learning outcomes were ≥ the minimum completeness criteria, and the teacher had to provide repeated enrichment so that students achieve their learning completeness. The main difficulty for students is adjusting mathematics in applied problems. Students also experience confusion in developing mathematical skills, this can be seen when they are given different questions from the examples given by the teacher. The low learning outcomes of students 'mathematics can be seen based on the results of students' answers as below.

Problem 1: Sinta drives a motorcycle with an initial speed of 2 m / s, without realizing it turns out that Sinta is 6 meters away from her house, then after 25 seconds it turns out that the distance she has traveled has increased by 24 meters. How far is Sinta now?

Based on the students' answers above, it was clear that the students did not understand what was being asked from the questions. Students only calculate what is known from the problem by relating it to the physics formula. From the students' answers, it can be seen that students only wrote down the formula in moderation. The use of other field formulas is correct, but with the question being asked not exactly right. So that the ability of students to understand displacement related to other subject areas has not been understood.

Problem 2: A family photo measuring 4 mx 6 m, will be displayed in the family room. So that the photo is enlarged to be 12 m x 18 m in size. How big is the photo enlargement?

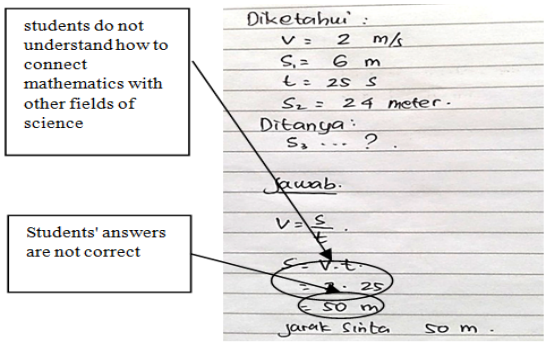

Figure 1. Student's Answer Results

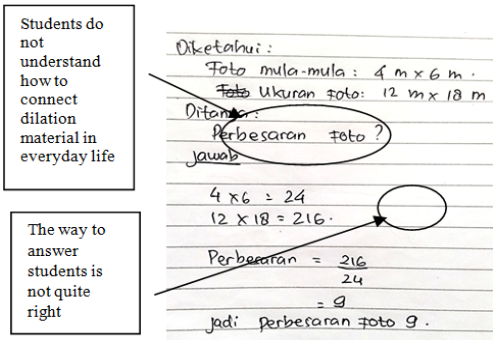

Figure 2. Student's Answer Results

Based on the students' answers, it appears that students only use their own methods which are not in accordance with the questions. So that students have not been able to understand the material of geometric transformation, namely dilation (enlargement) properly.

Furthermore, the researcher made observations in classroom learning to find out the causes of the problems above. Based on observations, it can be seen that the learning pattern that is applied teacher-centered learning in teaching mathematics concepts in the classroom in part tends to focus on the target material achievement and does not pay attention to aspects of students' mathematical abilities. In the learning process, students are less encouraged to develop their mathematical abilities. Particularly in classroom learning, students are directed to the ability to use formulas, memorize formulas, only work on questions, without relating them to real life. As a result, when students are given application questions or questions that are different from the practice questions, they experience difficulties.

What the teacher must do is provide a lesson that can encourage students to think, ask, solve problems, put forward ideas, discuss ideas and even find something new [1]. Teachers need to connect mathematics, ideas, applications and the real world. For this reason, it is necessary to have learning that can increase the understanding that students find themselves so that the problem solving is easier to understand.

Learning that must be developed is learning where students are subjects who have the ability to actively seek, process, construct, and use knowledge. For this reason, learning must be related to the opportunities given to students to construct knowledge in their cognitive processes [2]. One learning model that can be used as a solution to the above problems is the discovery learning model.

Discovery learning model has a good learning concept. Discovery learning strategies provide opportunities for students to become problem solvers, scientists, historians or mathematicians [3]. Through these activities, students will master the material, apply, and find things that are useful for themselves so that they can optimize learning outcomes [4,5].

Children must play an active role in learning in class [6]. Lessons can be taught effectively in an intellectual form according to the stage of the child's development, that is, in a meaningful way that increases in the same direction. These stages are; (1) Enactive stage, children carry out activities in an effort to understand the environment, namely using motor knowledge such as touch, biting; (2) Iconic stage, children understand objects through images and verbal visualization; (3) Symbolic stage, children have abstract ideas or ideas that are influenced by their ability to speak and logic [7,8].

Bruner's theory is used in this study because it relates to discovery learning, where students actively discover and learn concepts in their own language. This theory has the perspective that students process information and lessons through their efforts to organize, store, and then find a relationship between new knowledge and existing knowledge. This theory emphasizes how information is processed.

The mathematics learning outcomes of students who use the discovery learning model are better than the mathematics learning outcomes of students whose learning does not use the discovery learning model [9]. Learning with the Discovery Learning model with the scientific approach can effectively improve students' creative thinking completeness [7]. Discovery learning model is an alternative in improving student learning outcomes, especially in mathematics, because discovery learning involves many students to be more active in developing their knowledge [10].

2. Literature Review

2.1. Learning Tools

Learning tools are training-oriented resources with learning content [11,12]. Learning tools facilitate the learning process by providing the information needed to achieve knowledge and skills. Learning tools make learning more interesting, practical, realistic and fun. The existence of learning tools allows teachers and students to participate actively and effectively in learning.

In education, learning tools need to be developed to improve the quality of teaching and learning. The development of learning tools begins with the identification of learning problems encountered in class. What is meant by learning problems in the development of learning tools is problems related to learning tools, such as syllabus, teaching materials, student worksheets, learning media, tests to measure learning outcomes, and so on. Learning tools are considered a problem because they do not exist, or exist but do not meet the learning needs, or exist but need to be repaired, and so on.

2.2. Discovery Learning Model

Discovery learning is a learning model that aims to train students to find concepts independently [13] and suppress student activeness [14]. In discovery learning, students are encouraged to learn on their own, namely through active involvement with concepts and principles. The teacher's job is to encourage students to have experience and to experiment by enabling them to discover principles or concepts for themselves.

In the implementation of the discovery learning model in the classroom, there are several procedures that must be carried out, among them; (1) stimulation; (2) problem statement; (3) data collection; (4) data processing; (5) verification; (6) generalization [15,16,17]. The role of the teacher in implementing the Discovery Learning model is as a guide that facilitates students to learn actively and lead to learning goals [18,19,20].

2.3. Development of Learning Tools

The development of learning tools can be applied several research models to develop learning tools. Some of the research and development models commonly used in developing learning tools are Kaufman Model, Kemp Model, IDI, ADDIE, Dick & Carey, 4-D, and the others. However, the development model used is the Dick & Carey model with ten steps; (1) identify instructional

goal(s); (2) conduct instructional analysis; (3) analyze learnes and contexts; (4) write performance objectives; (5) develop assessment instruments; (6) develop instructional strategy; (7) develop and select instructional materials; (8) design and conduct formative evaluation of instruction; (9) revise instruction; (10) design and conduct summative evaluation [21].

2.4. Quality of Learning Tools

In preparing learning tools, means are also provided to control the quality of learning tools [12]. Even though a teacher prepares the best possible learning tools, they cannot claim that their learning tool is capable of achieving learning objectives or sure about how students respond to learning tools. For this reason, learning tools must be known about the level of validity, practicality and effectiveness.

Validity is an effort to produce a high quality tools. Validity in a development research includes content validity and construct validity [22]. The components of construct validity indicators in general are; (1) format; (2) language; (3) illustration; (4) content concept; (5) learning objectives [23]. Effectiveness refers to the degree to which the experience and results of the intervention are consistent with the intended purpose. Learning effectiveness indicators can be based on the achievement of learning completeness, classical learning completeness, achievement of learning objectives completeness, time used in learning [24].

3. Methodology

This type of research is Research and Development using Dick and Carrey Model.

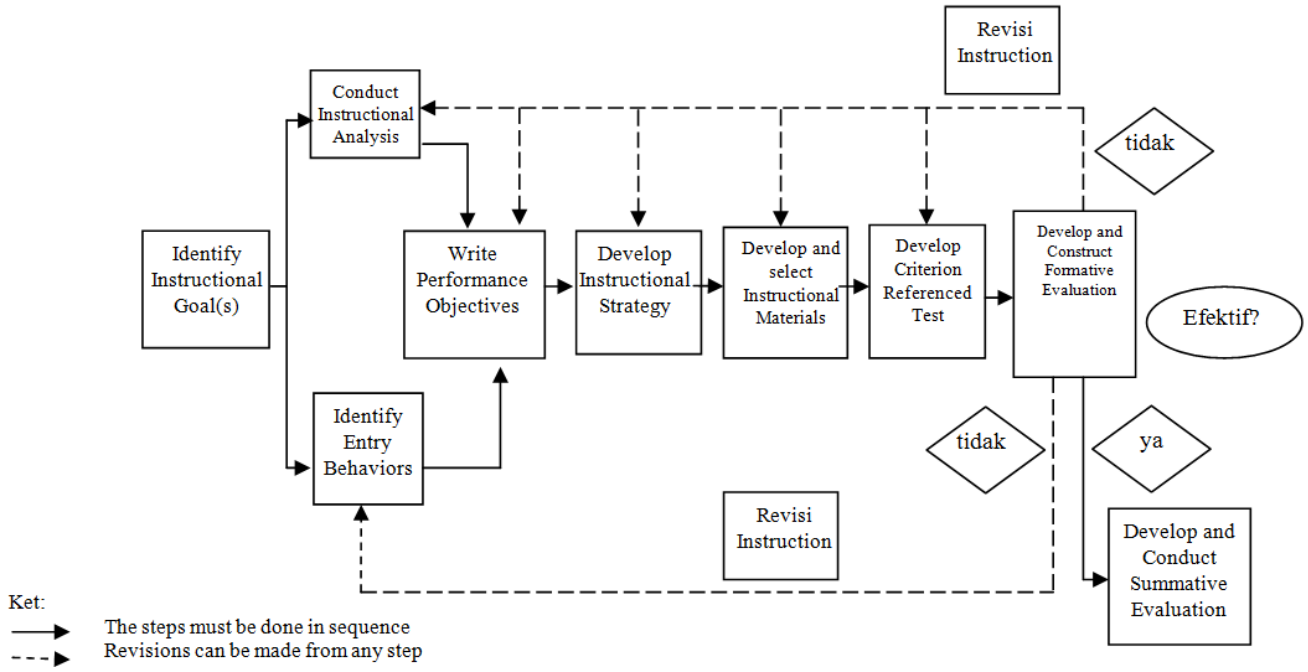

Figure 3. The Dick & Carey Development Design Model [21]

Learning tools developed are teacher books (BG), student books (BS), lesson plans (RPP), student activity sheets (LAS). The development of learning tools must be measured for the level of validity, practicality and effectiveness. To see the level of validity used a learning tools validation sheet with a Likert scale as the instrument. The validation process is carried out by a validator who provides results and suggestions on the format, language, and content of the learning tools. The data obtained is then looked at the level of validity by determining the average value of the experts for each indicator, determining the mean value for each aspect and determining the total mean value (Va) with criteria.

Then to determine the level of practicality used student activity observation sheets and student and teacher response questionnaires to the discovery learning model. The analysis carried out is to determine the value of the teacher's ability (KG) [26], dengan kriteria; (1) 1,00 ≤KG < 1,50 = not good; (2) 1,50 ≤KG < 2,50 = less good; (3) 2,50 ≤KG < 3,50 = good; and (4) 3,50 ≤KG < 4,50 = very good [27]. Actions or responses taken by students to stimuli in the form of teaching can be categorized; (1) positive response (listening, reading, writing, discussing / asking questions); and (2) negative responses (actions that are not relevant to learning).

Learning effectiveness indicators can be based on the achievement of completeness of learning> 65%, classical learning completeness> 85%, achievement of completeness of learning objectives> 75%, and the time used is faster [24].

Table 1. Validity Criteria

total mean value (Va)	Validity Criteria
1 ≤ Va < 2	invalid
2 ≤ Va < 3	less valid
3 ≤ Va < 4	quite valid
4 ≤ Va < 5	Valid
Va = 5	very valid

[25].

4. Results and Discussion

4.1. Identify Instructional Goal(s)

Based on a questionnaire with 15 teachers as respondents at SMAN 1 Binjai, it was concluded that student learning outcomes experienced problems and direct observation was obtained that 40% of students had low learning outcomes. In addition, it was also found that the teachers were not good at learning media, especially in geometry transformation material. In terms of curriculum, the curriculum used by SMAN 1 Binjai is the 2013 curriculum and geometry transformation material in odd semesters includes reflection, translation, dilation and rotation as well as geometric transformation composition.

4.2. Conduct Instructional Analysis

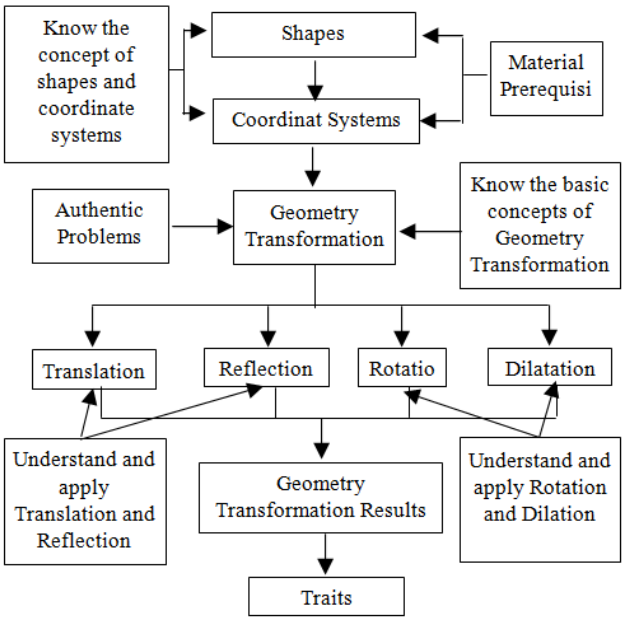

Figure 4. Chart of Learning Tool Analysis

4.3. Analyze Learnes and Contexts

Students at SMAN 1 Binjai have an average age of 16-17 years, at this time the cognitive development of students, according to Piaget, has entered the formal operational stage [28]. This stage is marked by the ability of students who are able to think abstractly and logically, students can formulate several possible answers and draw conclusions. However, from the results of the analysis of the students' academic ability at SMAN 1 Binjai it was classified as low. This can be seen from the average mathematics learning outcomes that are smaller than the KKM (75). Learning is one way in which the teacher acts as the only source of information that conveys knowledge to students. Students tend to be passive in learning by receiving information and recording it in notebooks. The learning tools used in SMAN 1 Binjai have not been able to improve student learning outcomes. Therefore, it is necessary to develop learning tools that are tailored to the characteristics of students at SMAN 1 Binjai. With the application of these learning tools it is expected to improve the quality of mathematics learning.

4.4. Write Performance Objectives

Table 2. Sub Topics and Learning Objectives of Each Meeting

Sub Topics	Learning Objectives
Properties of geometric transformations and their solutions	a) Able to analyze the properties of geometric transformations in real-life problems b) Able to apply the properties of geometric transformations to find concepts in problems related to other subjects c) Able to apply the concept of geometric transformation in solving mathematical relations problems

4.5. Develop Assessment Instruments

After formulating specific learning objectives, the researcher developed an assessment instrument tailored to the learning objectives. The learning outcome test is arranged to determine the extent of students' mastery of the geometric transformation material. This test is in the form of a structured description item consisting of 4 items and will be presented at the end of each trial after treatment using discovery learning tools. In preparing the learning outcomes test, several activities were carried out, namely; (1) making grids; (2) designing problems according to the basic competency indicators to be achieved; (3) making alternative solutions to problems; and 4) create a scoring rubric. Furthermore, the tests that have been prepared are assessed by a validator who assesses, format, content and language. The results of the validation of the learning outcomes instrument.

Table 3. Results of the Validation of Learning Outcomes Test

No	Validator	Question Items			
		1	2	3	4
1	Vaidator 1	RK	RK	RK	RK
2	Vaidator 2	TR	TR	TR	TR
3	Vaidator 3	TR	TR	TR	TR
4	Vaidator 4	TR	TR	TR	TR
5	Vaidator 5	TR	TR	TR	TR

Explanation:
TR = Can be used without revision
RK = Can be used with little revisions.

Then statistically, the validity level of the instrument for all item items was declared valid, the reliability level was 0.62 (reliable).

4.6. Develop Instructional Strategy

At this stage, determine the learning strategy that will be applied so that student learning outcomes can improve. This development is summarized in the lesson plan. The learning strategy developed is a discovery learning model, all activities caused by the conveyed learning will be synchronized with the learning tools. In the development stage, validation of draft I to experts is then carried out by field trials. Expert validation is focused on the format, content, illustrations, and language of the learning tools developed. The results of expert validation are in the form of validation values, corrections, criticisms, and suggestions which are used as the basis for revising and improving the learning tools developed. The revised

learning tool is a learning tool that has met the valid criteria and is hereinafter referred to as draft II.

4.7. Develop and Select Instructional Materials

One of the learning tools developed is a student book and student activity sheets. Therefore, the teaching materials chosen are student books and student activity sheets that have been developed. The use of these two tools is because these two tools have been adapted to the Discovey Learning.

4.8. Design and Conduct Formative Evaluation of Instruction

The lesson plan is designed for three meetings with the principles and characteristics of the K-13 curriculum which includes; 1) education unit; (2) Class / semester; (3) Main material; (4) Allocation of time; (5) Core competencies; (6) Basic competence; (7) Competency achievement indicators; (8) learning objectives; (9) learning materials; (10) learning approaches and methods; (11) learning activities; (12) Media / tools and learning resources; and (13) Assessment [29].

Student books are structured so that students have guidelines in understanding the subject matter in accordance with the set learning objectives. The developed student book contains contextual problems that must be solved in groups and independently, the solutions of which lead to the student's process of finding geometric transformation concepts, and at the end of the sub-chapter, practice questions are given to practice student learning outcomes. Apart from content, format and language are components that are considered in the process of developing student books. Based on the student's book, the teacher's book is also arranged, to make it easier for teachers to apply, using discovery learning tools.

LAS is a complement to student books as a place to write student answers that have been obtained in groups based on the problems found in LAS and student books. LAS was developed in accordance with the discovery learning model. The LAS contains the names of group members, time allocation, learning objectives, instructions for use, and a place to write down the answers to each question. At this stage expert validation is also carried out on learning tools, each validator provides different suggestions according to their respective fields, mathematicians ask to change the content in student books, then to practitioners, ask to adjust the lesson plan format according to K-13 and other recommendations.

Table 4. Learning Tool Development Trial Results

Trial	Aspect	Indicator
I	Learning outcomes	low (28,12%) medium (71,88%) high (0 %)
	Effectiveness	Classical learning completeness (68,75%) Achievement of learning objectives (72,39%) Student response (85,52%) Learning time (longer)
	Practicality	Expert validation (medium revision) Classroom manajemen (less good)
II	Learning outcomes	low (9,37%) medium (83,38%) high (6,25 %)
	Effectiveness	Classical learning completeness (87,50%) Achievement of learning objectives (83,38%) Student response (93,23%) Learning time(same)
	Practicality	Expert validation (litle revision) Classroom manajemen (good)

4.9. Revise Instruction

Furthermore, other factors that also affect the quality of development results that have not met the effective criteria, so it is necessary to revise several components of learning tools in the hope that learning tools with discovery learning models can improve student learning outcomes. In the following section, each component that needs revision will be explained.

4.9.1. Revise the Lesson Plans

To determine revisions to the lesson plan, the researcher looked at the results of observations during the learning process which were carried out three times. There are things that need to be improved in the lesson plan, namely the aspect of time management, especially during group presentations, because not all group representatives can present the results of their discussions in front of the class.

4.9.2. Revise Teacher's Book and Student Book

Table 5. Revised Teacher's Book and Student Book

Before revised	**After revised**
Problem Solving 1: (student book): 'Kemudian untuk lebih memahami maslah rotasi diatas, isilah tabel 10.7 berikut'	Problem Solving 1: (student book): 'Kemudian untuk lebih memahami maslah rotasi diatas, isilah berikut'
Problem 1 (Teacher's Book): finding translation concept formulas 'Begitu juga dengan titik C dan D memiliki perubahan yang sama T(2,-3). Sehingga untuk menemukan B' (10,1). B'(10,1) = B(8,4)+T(2,-3) Titik C, C(8,4)+T(2,-3)=C'(10,1) Titik D, D(8,4)+T(2,-3)=D'(5,7)'	Problem 1 (Teacher's Book): finding translation concept formulas 'Begitu juga dengan titik C dan D memiliki perubahan yang sama T(2, -3). Sehingga untuk menemukan B'(10,1). B'(10,1)=B(8,4)+T(2,-3) Titik C, C(8,4)+T(2,-3)=C'(10,1) Titik D, D(10,1)+T(2,-3)=D'(12,2)'
Translation problem 1 Gambarlah bangun datar ABCD dengan koordinat titik A(2,1), B(5,7), C(8,7), dan D(8,4). Kemudian pindahlah gambar tersebut sejauh (2,-3). Tentukan bayangan bangun ABCD. Langkah memindahkan bangun ABCD lihat pada lampiran buku ini.	Translation problem 1 Gambarlah bangun datar ABCD dengan koordinat titik A(2,1), B(5,7), C(8,7), dan D(8,4). Kemudian geserlah gambar tersebut sejauh (2,-3). Tentukan bayangan bangun ABCD. Langkah memindahkan bangun ABCD lihat pada lampiran buku ini.

The revision of the student book was carried out by perfecting the Alternative Solutions to Problem 1, with the consideration that some students had difficulty understanding the questions that were not contained coherently as well as some wrong questions that were not in accordance with the instructions for the work. Revision of the teacher's book is done by correcting writing errors in “Latihan” for the sub-topic of reflection, with the consideration that some students had difficulty understanding questions that were not written correctly. Then in the teacher's book and student book section Problem 1 for the translation sub-topic, said ‘pindahkan’ needs to be fixed with ‘geserlah’ at the end of the sentence. Details are in Table 5.

4.9.3. Revised Student Activity Sheet (LAS)

The LAS revision based on the results of the first trial based on the revised student book revision in the student book is also included in the LAS. Another revision of LAS is to provide a wider page for solving problems and problems. The results of trial I are used as a reference for improving discovery learning tools. The results of the revisions made on the results of trial I are called draft III and will be retried in trial II.

4.10. Design and Conduct Summative Evaluation

Based on the data obtained from the results of trial I and trial II, it will be known whether the problem formulations and research questions posed in the previous section have been answered or not. The results of data analysis obtained from the results of trial I and trial II indicate: (1) the validity of the learning tools developed using discovery learning models in improving student learning outcomes; (2) the practicality of discovery learning tools in improving student learning outcomes; (3) the effectiveness of discovery learning tools in improving student learning outcomes.

4.10.1. The Validity of Discovery Learning Tools

Learning tools that have been compiled through the define and design stages in the form of draft I are tested for validity beforehand by submitting all the components of the developed learning tools such as lesson plans, student activity sheets (LAS), teacher books (BG), student books (BS) and tests. learning outcomes to experts.

It can be concluded that the results of the validation for each component of the learning tools with the discovery learning model developed are in the "valid" category with the average value of each component, namely: lesson plan (4.38); teacher's books (4,30); student books (4.32) and LAS (4.33). But even though the components of the discovery learning tools have met the validity criteria, there are several things that must be improved according to the notes provided by the experts, including the use of language, writing or typing and the appearance of images which must be in accordance with the material conditions. So based on the results of notes from experts that this learning tools has met the validity criteria with the "valid" category with a note of little revision or no revision.

4.10.2. The practicality of discovery learning tools

The practicality of the discovery learning tools that will be developed is seen from two aspects, namely the results of the validation of the learning tools and the use of discovery learning tools in the implementation of learning. The results of the validation of learning tools were declared valid even though there were few or no revisions. As for practicality, it is reviewed from the results of interviews with several students with different levels of knowledge. Where students feel helped by the existence of this learning tool, besides that students feel happy in following the learning using discovery learning tools, this was expressed by students on the grounds that they were happy when involved in the learning process.

In addition, students feel happy and helped in using the LAS that was developed on the grounds that the LAS arranged is different from LAS in general, and in this LAS students are directly involved in finding mathematical concepts through experiments that involve all their abilities and potentials. Students also feel happy with the problems posed because they are raised from problems that are not far from their lives besides that the problems link previous lessons related to rectangles, so that students know the linkages in learning mathematics itself or with real life students or with other disciplines. From the results of expert validation and interviews, it can be concluded that the learning tools with the discovery learning model that has been developed is "practical" to be used in learning.

4.10.3. The Effectiveness of Discovery Learning Tools

The results of trial I and trial II, discovery learning tools have met the effective category in terms of: (1) classical student completeness; (2) achievement of learning objectives; (3) student response and (4) learning time. In the following, a discussion of each indicator will be presented in measuring the effectiveness of the learning tools developed with the discovery learning model.

Classical student learning completeness

The results of the posttest analysis in trial I and trial II showed that student learning outcomes had met the completeness criteria classically. This is because the learning materials and contextual problems in student books and LAS are developed according to the characteristics and culture of students so that students can use previous experiences and utilize knowledge from their daily environment to solve mathematical problems that make the learning process more meaningful. Meaningful learning is a process of linking new information or material with existing concepts in a person's cognitive structure [30]. Cognitive structures are facts, concepts, and generalizations that students have learned and remembered. This means that meaningful learning occurs when students try to connect new information or material in the structure of their knowledge to solve the problems they face.

Student learning completeness is also influenced by the learning approach used in the learning process. Discovery learning model that makes students interested in learning and actively involved in the learning process [31]. Therefore, discovery learning should be used as an

alternative learning by the teacher in order to develop student learning outcomes.

In addition, discovery learning tools can also help improve mathematics learning outcomes, more precisely aspects of students' mathematical connection abilities [32]. So that it can be interpreted that students with high mathematical connection skills have high learning outcomes, on the other hand, if students with low mathematical connection skills, learning outcomes are low. Discovery learning model orientates Vygotsky's theory which views that humans can build mathematical concepts by adapting to social environments. Vygotsky's theory views that social and learning environments can influence children's development in enhancing their cognitive abilities [33]. Children's intellectual development is influenced by social factors in learning, where during learning there is mutual influence between language and actions in social conditions. Thus it can be concluded that discovery learning tools help students achieve classical learning completeness.

Achievement of Learning Objectives

In the first trial, it was found that the achievement of the learning objectives of students' mathematics learning outcomes in the test had not been achieved, while in the second trial the learning objectives of learning mathematics learning outcomes had been achieved for each item of question. The achievement of learning objectives is fulfilled because the learning tools are surveyed using contextual materials and problems that are close to the life and culture of students so that they can be reached by the students' imagination, making it easier for students to find various possible solutions by modeling in the form of symbols or mathematical equations in solving problems . This is relevant to Bruner's theory, because at the beginning of learning students carry out activities such as making observations in the environment or using knowledge from previous observations in the learning process (enactive stage). Furthermore, to help students understand contextual problems, in the student books and student activity sheets, pictures related to the contextual problem are presented (the iconic stage), and in the process of solving contextual problems students perform mathematical modeling in the form of symbols or mathematical equations and solve the contextual problem with the model found (symbolic stage).

The achievement of learning objectives is also because in the learning process the students' mindset is developed from concrete to abstract things that have been adjusted to the student's cognitive development. Piaget's cognitive development of students at the age of 13-14 years has entered a formal operational stage which is marked by the ability of students who are able to think abstractly and logically, besides that students are also able to look for various possible solutions and conclude [34].

Learning Time

The learning time using learning tools with discovery learning models is the same as the length of time online learning has been carried out so far, namely four meetings or 8 x 40 minutes. Thus the learning time used is in accordance with the learning time criteria, namely the achievement of the learning time used does not exceed the usual learning time, so it can be concluded that the achievement of learning time in trial I and trial II has been achieved.

The achievement of learning time cannot be separated from the approach and learning tools used during the learning process, namely by using discovery learning learning tools to make students active in the learning process and teachers can use time as effectively as possible for the success of the learning process [35]. The length of time given to students to study the material presented is something that must be considered by the teacher because learning will take a lot of time [36]. So that the learning time must be planned by the teacher in order to create effective and efficient learning. Based on the description above, it can be concluded that the learning time using discovery learning learning tools meets the criteria of being effective.

Student Response

The average percentage of student responses in each trial is positive, meaning that overall students feel helped and are happy with the discovery learning tool developed. Student responses in each trial have met the criteria, namely $\geq$ 80%. This shows that the discovery learning tools developed have met the criteria for being effective.

Positive responses given by students to discovery learning tools. Learning using discovery learning tools is meaningful learning that is integrated with student culture so that it makes students interested in learning, is actively involved in the learning process, and responds positively to the learning tools used [37]. In addition, positive responses to discovery learning tools, positive responses from students to teachers who have provided stimuli in the form of feedback and reinforcement in the learning process [31]. The learning stages that students go through in discovery learning make students able to evaluate their own thinking and the thoughts of others so as to deepen their mathematical abilities and make students closer to mathematics itself. Thus discovery learning tools contribute positively to student responses.

Based on the effectiveness indicators described above, classical student learning completeness, achievement of learning objectives, time used for learning and student responses to learning tools, it can be concluded that discovery learning tools are effective.

5. Conclusion

After carrying out a series of stages in developing the Discovery Learning learning tools, it fulfills the requirements of validity (expert validation), practicality (practitioner validation and classroom management) and effectiveness (classical completeness, achievement of learning objectives, learning time and student response) by conducting two trials.

Acknowledgements

Gratitude to related parties, supervisors, all unimed postgraduate academic community, SMA Negeri 1 Binjai, Binjai Education Office. Especially thanks to my parents who gave memorial support and materials to researchers.

References

[1] D. Van Walle, *Elementary Middle School Mathematics*. Jakarta: Erlangga, 2007.

[2] Hosnan, *Pendekatan Saintifik dan Kontekstual dalam Pembelajaran Abad 21*. Jakarta: Galian Indonesia, 2014.

[3] A. R. Fauzi, Z. Zainuddin, and R. Al Atok, "Penguatan Karakter Rasa Ingin Tahu dan Peduli Sosial melalui Discovery Learning," *J. Teor. dan Praksis Pembelajaran IPS*, vol. 2, no. 2, pp. 79-88, 2017.

[4] E. Hulukati, S. Zakiyah, and A. Rustam, "The Effect of Guided Discovery Learning Model with Superitem Test on Students' Problem-Solving Ability in Mathematics," *J. Soc. Sci. Stud.*, vol. 5, no. 2, pp. 210-219, 2018.

[5] D. Ismunandar, "Pembelajaran Menggunakan Model Discovery Learning Terhadap Kemampuan Koneksi Matematik," *Snmpm Ii Unswagati*, pp. 193-201, 2018.

[6] Dalyono, *Psikologi Pendidikan*. Jakarta: Rineka Cipta, 2005.

[7] F. Indiastuti, "Pengembangan Perangkat Model Discovery Learning Berpendekatan Saintifik Untuk Meningkatkan Berpikir Kreatif Dan Rasa Ingin Tahu," *J. Pendidik. Mat. RAFA*, vol. 2, no. 1, pp. 41-55, 2017.

[8] K. Takaya, "Jerome Bruner's Theory of Education: From Early Bruner to Later Bruner," *Interchange*, vol. 39, pp. 1-19, 2008.

[9] F. Fitriyah, A. Murtadlo, and R. Warti, "Pengaruh Model Pembelajaran Discovery Learning terhadap Hasil Belajar Matematika Siswa MAN Model Kota Jambi," *J. Pelangi*, vol. 9, no. 2, pp. 108-112, 2017.

[10] M. Surur and S. T. Oktavia, "PENGARUH MODEL PEMBELAJARAN DISCOVERY LEARNING TERHADAP PEMAHAMAN KONSEP MATEMATIKA," *JPE (Jurnal Pendidik. Edutama)*, vol. 6, no. 1, pp. 43-52, 2019.

[11] A.-R. B. Olayinka, "Effects of Instructional Materials on Secondary Schools Students' Academic Achievement in Social Studies in Ekiti State, Nigeria," *World J. Educ.*, vol. 6, no. 1, pp. 32-39, 2016.

[12] C. P. Campell, "Instructional materials: their preparation and evaluation," *J. Eur. Ind. Train.*, vol. 23, no. 2, pp. 57-107, 1999.

[13] N. Sulistyowati, A. T. Widodo, and W. Sumarni, "Efektivitas Model Pembelajaran Guided Discovery Learning Terhadap Kemampuan Pemecahan Masalah Kimia," *Chem. Educ.*, vol. 2, no. 1, pp. 49-55, 2012.

[14] T. B. Setiawan, Suharto, and A. Susanto, "Pengembangan Perangkat Pembelajaran Matematika Model Discovery Learning dengan Memperhatikan Beban Kognitif pada Materi Trigonometri Kelas X SMK," *Kadikma*, vol. 7, pp. 1-9, 2016.

[15] Yaumi, Wisanti, and S. Admoko, "Penerapan Perangkat Model Discovery Learning pada Materi Pemanasan Global untuk Melatihkan Kemampuan Literasi Sains Siswa SMP Kelas VII," *E-Journal Pensa*, vol. 05, no. 1, pp. 38-45, 2017.

[16] L. Hutapea, "Penerapan Model Pembelajaran Discovery Learning Berbantuan Program Cabri 3D untuk Meningkatkan Hasil Belajar Peserta Didik Materi Pokok Dimensi Tiga," *Desimal J. Mat.*, vol. 2, no. 1, pp. 77-85, 2019.

[17] Y. Heryani and D. Setualesmana, "Kontribusi Penggunaan Model Discovery Learning terhadap Peningkatkan Kemampuan Koneksi dan Komunikasi Matematik pada Mahasiswa Program Studi Pendidikan Matematika Angkatan 2015-2016.," *J. Siliwangi*, vol. 3, no. 1, pp. 190-196, 2017.

[18] W. J. Damanik and E.. Syahputra, "Pengembangan Perangkat Pembelajaran Untuk Menigkatkan Kemampuan Berpikir Kreatif Matematis Siswa Menggunakan Model Discovery Learning," *Inspiratif J. Pendidik. Mat.*, vol. 4, no. 1, pp. 27-38, 2018.

[19] I. S. W. Hayati, U. Manzilatusifa, and S. Handoko, "Pengaruh Penerapan Model Discovery Learning terhadap Kemandirian Belajar SIswa," *JP2EA (Jurnal Pendidik. dan Pembelajaran Ekon. Akuntansi)*, vol. 3, no. 1, pp. 75-80, 2017.

[20] D. Julianingsih, "Pengembangan Perangkat Pembelajaran Penemuan Terbimbing untuk Melatih Kemampuan Berpikir Kritis Siswa," *J. Akrab Juara*, vol. 3, no. 3, pp. 20-37, 2018.

[21] W. Dick, L. Carey, and J. O. Carey, *The Systematic Design of Instruction*, 6th ed. Boston, 2009.

[22] Rochmad, "Desain Model Pengembangan Perangkat Pembelajaran Matematika," *Kreano J. Mat. Kreat.*, vol. 3, no. 1, pp. 59-72, 2012.

[23] J. . Akker, *Principles and Methods of Development Research. Educational Design Research*. Arizona: Rotledge, 2006.

[24] Hasratuddin, *Mengapa Harus Belajar Matematika?* Medan: Perdana Publishing, 2015.

[25] B. Sinaga, "Pengembangan model pembelajaran matematika berdasarkan masalah berbaisi budaya batak," Universitas Negeri Surabaya, Surabaya, 2007.

[26] D. Yusra and S. Saragih, "The Profile of Communication Mathematics and Students' Motivation by Joyful Learning-based Learning Context Malay Culture," *Br. J. Educ. Soc. Behav. Sci.*, vol. 15, no. 4, pp. 1-16, 2016.

[27] V. Damopolii, N. Bito, and R. Resmawan, "Efektivitas Media Pembelajaran Berbasis Multimedia Pada Materi Segiempat," *Algoritm. J. Math. Educ.*, vol. 1, no. 2, pp. 74-85, 2020.

[28] F. Ibda, "Perkembangan Kognitif: Teori Jean Piaget," *Intelektualita*, vol. 3, no. 1, pp. 27-38, 2015.

[29] Kemendikbud, *Lampiran Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 65 Tahunn 2013 tentang Standar Proses*. Jakarta, 2013.

[30] Trianto, *Mendesain Model Pembelajaran Inovatif Progresif*. Jakarta: kencana Prenanda Media Group, 2011.

[31] E. Susanti, A. Rodiawati, and S. S. Syam, "Discovery Learning untuk Meningkatkan Kemampuan Pemahaman dan Koneksi Matematis," *Prosiding Seminar Nasional Matematika dan Pembelajaran*, Yogyakarta, pp. 1113-1122, Nov. 2018.

[32] M. Azizah and F. Fauziyah, "Pengaruh Kemampuan Koneksi Matematika Terhadap Hasil Belajar Siswa Pada Materi Garis Singgung Lingkaran Kelas VIII SMPN 2 Sumbergempol Tulungagung," *J. Pendidik. Mat. RAFA*, vol. 5, no. 1, pp. 1-9, 2019.

[33] Y. T. Suci, "Menelaah Teori Vygotsky Dan Interdepedensi Sosial Sebagai Landasan Teori Dalam Pelaksanaan Pembelajaran Kooperatif Di Sekolah Dasar," *Nat. J. Kaji. Penelit. Pendidik. dan Pembelajaran*, vol. 3, no. 1, pp. 231-239, 2018.

[34] P. Suparno, *Teori Perkembangan Kognitif Jeans Piaget*. Yogyakarta: Kenisus, 2001.

[35] R. E. Slavin, *Cooperative Learning Teori, Riset dan Praktik*. Bandung: Nusa Media, 2011.

[36] K. Yuliani and S. Suragih, "The Development Of Learning Devices Based Guided Discovery Model To Improve Understanding Concept And Critical Thinking Mathematically Ability Of Students At Islamic Junior High School Of Medan," *J. Educ. Pract.*, vol. 6, no. 24, pp. 116-128, 2015.

[37] A. Trianingsih, N. Husna, and N. C. Prihatiningtyas, "Pengaruh Model Discovery Learning terhadap Pemahaman Konsep Matematis Siswa pada Materi Persamaan Lingkaran di Kelas XI IPA," *Variabel*, vol. 2, no. 1, p. 1, 2019.