

Development of Physics Teaching Materials of Optical Devices Based on Learning Assisted Guided Inquiry Crossed Puzzles

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ABSTRACT

This research aims to produce the teaching materials based on the inquiry learning model with valid, effective, and practical crossword puzzle of a physics lesson, especially in the optical appliance material of junior high school. The type of this research is developmental research using a 4 D model. The 4-D model consists of 4 stages of defining, designing, developing, and distributing. This research uses the development model. The methodology used is quantitative descriptive. Likert scale is used in this research as the validity analysis. Furthermore, the practical analysis is achieved from observation instrumental of lesson plan implementation, which written in the observation sheet, and student and teacher response questionnaire. The result of the research showed that the validity analysis of teaching material is valid. Moreover, the result of lesson plan implementation, teacher response questionnaire, student response questionnaire, categorized to very practical. The findings of this research showed that inquiry learning with a crossword puzzle in optical appliance material was very valid, practical, and useful.

ABSTRAK

Penelitian ini bertujuan untuk menghasilkan bahan ajar berbasis model pembelajaran inkuiri terbimbing berbantuan teka-teki silang (TTS) yang valid, efektif dan praktis pada pembelajaran fisika SMP untuk materi alat-alat optik. Jenis penelitian ini adalah penelitian pengembangan dengan menggunakan model 4-D. Model 4-D terdiri 4 tahapan pendefinisian, perancangan, pengembangan dan penyebaran. Penelitian ini menggunakan menggunakan model pengembangan. Analisis validitas dilakukan dengan menggunakan skala Likert. Analisis praktikalitas diperoleh dari instrumen pengamatan keterlaksanaan RPP yang ditulis dalam lembar observasi, dan angket respon siswa dan angket respon guru. Hasil penelitian menunjukkan analisis validasi bahan ajar didapatkan berada pada kategori sangat valid. Hasil angket keterlaksanaan RPP, angket respon guru, angket respon siswa, didapatkan bahan ajar berada pada kategori sangat praktis. Hasil analisis efektivitas bahan ajar berada pada kategori sangat efektif. Hasil penelitian menunjukkan berbasis model pembelajaran inkuiri terbantuan teka-teki silang pada materi alat-alat optik yang sangat valid, sangat praktis dan sangat efektif.

Keywords: Crossword puzzle; Guided Inquiry; Optical Devices; Teaching Materials.

INTRODUCTION

Education and learning are essential things to be obtained by both children and adults. Education is one of the capitals for a person to achieve fruitfulness and success in his life. A good education must be supported by good learning. Good learning seeks to change students who have not educated to be educated.

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Many factors influenced the success of educational quality, including teachers, students, facilities and infrastructures, environment, and curriculum. Based on it, the teacher would be the crucial factor besides others. Teacher as the conveyor of knowledge is the determinant of the educational quality success. Moreover, the teacher's quality can be seen when managing the learning process. Physics is the knowledge which is closely related to daily life. Humans commonly use physics theory and concepts in fulfilling daily needs. Based on Sagan, physics is not only the collection of

facts and principles but more than that, physics also contains ways to obtain these facts and principles and the attitude of physicists in doing so (Supriyono, 2003).

Based on the results of preliminary observations and interviews with the physics teacher of Bunayya Islamic Junior high School Padangsidempuan, the learning process with the assisted inquiry learning model's crossword puzzles is expected to improve student learning outcomes. Students are divided into groups of 5 people. They are expected to work together to discover the concepts of physics independently in the presence of a crossword puzzle that will make the learning process exciting and fun.

According to Trianto (2010) Physics learning is the science that studies the symptoms through a series of processes known as scientific processes that are built on the basis of scientific attitudes and the results are realized as scientific products composed of the three most important components in the form of universally applicable concepts, principles, and theories. Physics is one of the fields of science that is felt to be less attractive to many students. Monotonous learning and more often one direction or teacher center increasingly make physics learning boring. The teacher is one of the factors that influence the success or failure of a teaching and learning activity. For this reason, teachers are expected to use creative and innovative models, methods, and learning techniques in managing the learning process.

The inquiry learning model is one of the learning models which includes active, creative, and innovative. According to Sanjaya (2016), inquiry learning is "a series of learning activities which emphasize the critical and analytical thinking process to find and find answers to problems that questionable." Inquiry learning models are more likely to be student centers. The inquiry comes from English, which can be interpreted as the process of asking questions and finding out answers to the scientific questions that they put forward. The questions can lead to the investigation of the question object. In other words, the inquiry is a process to obtain and obtain information by conducting observations and or experiments to find answers or solve problems with questions or problem formulations. The steps of inquiry learning have six stages, namely: problem orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses, and formu-

lating conclusions.

The other reason for use inquiry method in laboratory learning is because of the meaning of teaching, making students knowing the previously unknown (Gilbert & Fensham, 1982). When the problem and phenomenon occurred in the world that found in the curriculum, the physicist and textbook are not enough to handle it (Borghini, 2002). Inquiry method learning is suggested to implementation in the study because it has provided increasing the ability of the student to understand the lesson (McBride, 2004).

Crossword puzzles help this learning process become more interesting. Crossword puzzles are a game where we have to fill in empty spaces (in the form of white boxes) with letters that form a word based on the instructions given. According to the Dictionary of Large Languages Indonesia (kbbi.web.id), puzzles are questions in the form of sentences (stories or pictures), which are expressed vaguely, which are commonly used for games or sharpening of thoughts.

According to the Ministry of National Education (2006), teaching material is a set of materials that are arranged systematically that allows students to learn and adapt to the existing curriculum. Teaching material is a set of materials that contain learning material or content to achieve learning objectives. A teaching material contains material or content in the form of ideas, facts, concepts, principles, rules, or theories that cover subjects according to their scientific discipline and other information in learning (Sungkono, 2003).

Teaching materials can be arranged in such a way that it becomes more interesting so that students feel happier and will be easier to learn the material. The development of teaching materials is based on the concept of learning design that is based on a competency or to achieve learning objectives (Lestari, 2013).

Some points must be considered in making teaching materials so that students can learn independently and obtain completeness in the learning process as follows: (1) Containing exciting examples and illustrations in order to support the presentation of learning material. (2) They are providing the possibility for students to provide feedback or measure their mastery of the material provided by providing practice exercises. (3) Contextual, i.e., the material presented is related to the atmosphere or context of the students' assignments and environments. (4) The language used is quite simp-

le because students only deal with teaching material when learning independently. (Widodo and Jasmadi, 2008).

The purpose of this study was to produce teaching materials of optical devices based on crossword-assisted inquiry learning models to increase students' learning outcomes

METHOD

The research conducted was development research (Research and Development), which produced products. The model used in this development is the 4-D Model (Four D Model) development model, which consists of four stages: define, design, develop, and disseminate (Thiangrajan and Semmel, 1974).

The subject of this research was teaching materials based on the crossword puzzle assisted inquiry learning model. This research was carried out at SMPIT Bunayya Padangsidempuan grade VIIIA 2017/2018 school year.

The steps for developing instructional materials could be detailed as follows:

Definition Stage

The definition stage included three main steps, namely, curriculum analysis, student analysis, and material analysis. According to Munawaroh (2009), there are four curriculum components, namely, objectives, content components, method components, and evaluation components. Curriculum analysis will be carried out on these four components. In the analysis of students, the analytical tool used is AUM PTSDL. AUM PTSDL is used to express problems faced by students. In material, the analysis aims to identify, detail, and compile the primary material systematically from the material of optical devices that will be used as the contents of the syllabus, lesson plans and teaching materials to be developed.

Design Stage

The second stage was the design stage. At this stage, the design of Physics teaching materials was designed on the material of optical devices based on a crossword-assisted inquiry approach consisting of syllabi, lesson plans, and teaching materials. At this stage of the design, two stages were carried out, namely the design of the instrument preparation needed in this study and the prototype of teaching materials. As shown in Figure 1.

Mendatar

3. Jarak bayangan lebih besar dari benda disebut
4. Alat yang digunakan untuk melihat benda yang ukurannya kecil
6. Titik api lensa disebut titik ...
7. Salah satu sifat bayangan pada kamera
10. Alat yang berfungsi untuk meneruskan sinar pada kamera
12. Layar tempat terbentuknya bayangan
14. Salah satu sifat bayangan pada lup
15. Bagian kamera untuk mengatur intensitas cahaya

Menurun

1. Lensa yang digunakan lup
2. Ruang tempat meletakkan benda saat menggunakan lup jika mata berakomodasi maksimum
5. Hasil cetakan pada kertas potret disebut ...
8. Lup sering digunakan oleh tukang ...
9. Bayangan yang dibentuk oleh film berupa gambar ...
11. Alat yang digunakan untuk merekam suatu kejadian
13. Bagian kamera tempat pembentukan bayangan

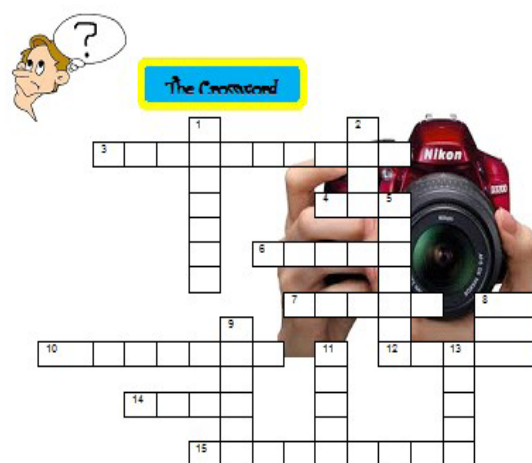


Figure 1. Crossword puzzles

The next stage was developed; at this stage would be tested for validity, practicality, and effectiveness. To test the validity of teaching materials would be assessed by five validators consisting of 2 Physics lecturers, one Indonesian lecturer, one Computer lecturer, and one practitioner from Bunayya Junior High School teacher. Practicality tests were carried out by asking the teachers' responses and students' responses after using teaching materials in the learning process. The practicality of teaching materials was also determined from the results of observing the implementation of the

Lesson plan during the learning process. Observations were carried out by two observers, the physics teachers of SMPIT Bunayya Padangsidempuan. The effectiveness of teaching materials was seen from the improvement of cognitive, affective, and psychomotor competence. Such as shown in figure 2.

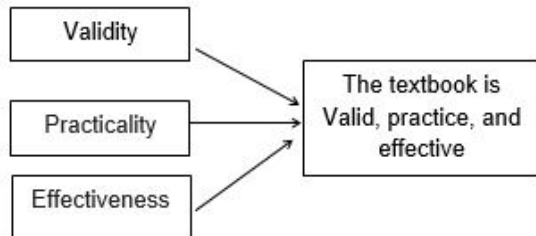


Figure 2. Scheme Development Stage

Dissemination Stage

The dissemination stage was carried out in different classes so that the effectiveness of learning devices was included, which included cognitive, affective, and psychomotor assessment. The subject of the trial was the instructional material based on the inquiry puzzle assisted learning model developed, while the respondents in this study were teachers and students of SMPIT Bunayya Padangsidempuan.

The data collection techniques are using

observation sheets of lesson plan implementation, teacher response questionnaire, student response questionnaire, and student learning outcomes.

Data analysis techniques using quantitative descriptive analysis, namely by describing the validity, practicality, and effectiveness of teaching materials using inquiry learning models assisted by crossword puzzles.

RESULTS AND DISCUSSION

Results of Defining Stage

At this stage, three aspects had been carried out, namely curriculum analysis, material analysis, and material analysis. Then this would determine each of these aspects.

Curriculum Analysis

The analysis of the curriculum stage results was obtained from four components, namely the components of objectives, content, methods, and evaluation. Based on curriculum analysis, results were obtained as in Table 1.

Student Analysis

The results of the students' data analysis showed that students of grade VIII-A of SMPIT Bunayya Padangsidempuan, with a total of 23

Table 1. Curriculum Analysis

Curriculum component and Results of Curriculum Analysis	
Aims	With physics learning, the graduates were expected to have behaviors that reflect the character of the Integrated Islamic School education with the formation of students who believe and fear Allah SWT in the form of honesty, responsibility, independence, cooperation and can think abstractly and concretely and master the stages in the physics learning process, so cognitive, affective and psychomotor domains are reflected in students.
Content Components	Competency Standards (CS) were areas in the aspects of knowledge, attitudes, and skills that students must learn. In the realm of knowledge, students were expected to "know what," and the realm of attitude was expected students "know why," and the realm of skills was expected students "know-how". Essential Competencies (BC) were competencies that students learn for subjects. From the existing BC, a teacher could make a lesson plan. The lesson plan for the material of optical equipment consisted of the lesson plan for 3 x meetings, namely the 1st meeting for eye material as an optical instrument, the 2nd meeting for camera material and magnifying glass, and the 3rd meeting for microscopes, binoculars, and periscopes. The prerequisite material for optical devices was light.
Component approach	The right learning model conducted by educators in delivering the material of optical tools was an inquiry-based learning model assisted by crossword puzzles.
Evaluation Components	<ol style="list-style-type: none"> 1. Assessment of the realm of knowledge through written test instruments in the form of crossword puzzles. CROSSED WORD PUZZLE instruments included scoring guidelines. 2. An attitude assessment was carried out through an observation sheet. 3. Skills assessment through observation sheets.

people passed students had an average age of 11-13 years. Student analysis was done by using AUM PTSDL. AUM that used to describe condition students PTSDL is a learning component, specifically called AUM PTSDL. AUM PTSDL is a learning component that used to describe the student situation. Prayitno (2008) explained that AUM PTSDL is an instrument with no test to support the counseling service to reveal the specific problems that happened in the students. The researcher collaborates with physics teachers and counseling in analyzing students. In the process of learning activities, the interaction between teachers and students was not optimal. Some students looked active, but some students tended to be passive and less enthusiastic because the teacher still used the teacher center learning process. Some students had not been able to formulate problems and questions. When the teacher gave problems and questions, only some who dared to ask or answer. Students only accepted what was given by the teacher so that students were still tricky in understanding the concept, and students' interest in physics was still low. Students always considered physics to be just a theory and formula, even though physics was in everyday life. This caused learning objectives were not achieved so that student learning outcomes were not good.

The ability of the students of SMPIT Bunayya Padangsidempuan as a whole was in the middle category. Based on the analysis, teaching materials with inquiry puzzle assisted learning models were following the conditions of students and their development stage. This teaching was expected to improve students' cognitive, affective, and psychomotor abilities.

Material Analysis

The Learning Material Development Guide issued by the Ministry of National Education explained that the initial step in analyzing learning material was the identification of competency standards and necessary competencies. As for the Competency Standards (CS) in this study were understood the concepts and application of wave vibration and optics in everyday technology products, while BC was describing visual tools and their application in everyday life.

The next step of the analysis was to identify the types of learning material. The material analysis was essential to be carried out before the development of teaching materials because it was used as a basis in knowing the

materials that were relevant to the demands of the curriculum so that it could be used to synergize learning models that were suitable to achieve learning objectives. The material analysis also provided an overview of practical approaches used in achieving the expected goals. The material analysis was the identification of the primary materials that would be taught and compiled them systematically and looked for the relevance of concepts learned with reality in everyday life. This analysis was intended to identify, detail, and systematically compile the main principles of the material of optical devices.

The essential competencies of optical instruments had been described into several material facts, concepts, principles, and procedures. These facts, concepts, principles, and procedures were developed in the syllabus, lesson plans, and teaching materials. The central concept of the material of optical devices was correlated with the step model of inquiry-based learning, where this model was expected to improve student learning outcomes in the cognitive, affective, and psychomotor domains. The central concept of the optical instrument material that used as the content of teaching materials was the eye as an optical instrument; camera and magnifying glass, microscopes, binoculars, and periscopes. The concept analysis result can see in Table 2.

Table 2. The fact, concept, principle, and procedure of eyes theory as optical devices

Aspect	Textbook
Fact	<ol style="list-style-type: none"> 1. Eyes are as optical devices 2. Eyes in a reasonable condition can look far or near the object
Concept	<ol style="list-style-type: none"> 1. Optical is a device that can reflect and refract light. 2. The kind of optical devices are eyes, camera, Magnifying glass, microscope, and telescope. 3. The part of the eyes is cornea, iris, and pupil, lens, retina, ciliary muscle, optic nerve. 4. The accommodation eyes are the ability of eyes to concave and convex. 5. The kind of defect eyes is myopic, hypermetropia, presbyopia.
Principle	<ol style="list-style-type: none"> 1. Enlargement of shadows for a maximum accommodation of eyes $M = \frac{25}{f} + 1$

	2.	The nature of the image formed is real, reversed, and minimized.
Procedure	1.	Teacher gives an introduction
	2.	The students do activities follow the teacher's instruction and textbook based on the inquiry method.
	3.	The student discusses the answer of a crossword
	4.	The teacher and student discuss and concluded together in the class.
	5.	The teacher evaluates the answer.

And then, The fact, concept, principle and procedure camera, and Magnifying glass can see in Table 3.

Table 3. The fact, concept, principle and procedure camera and Magnifying glass.

Aspect	Textbook
Fact	<ol style="list-style-type: none"> 1. The camera and Magnifying glass is an optical instrument because it has a lens. 2. The watchman use Magnifying glass to easy work
Concept	<ol style="list-style-type: none"> 1. The camera is used to video an object 2. The part camera is lens, shutter, diaphragm, and film 3. A magnifying glass is used to zoom an object.
Principle	The object is between O and F Magnifying glass, so the shading of the lens is virtual, vertical, and enlarge.
Procedure	<ol style="list-style-type: none"> 1. Teacher gives an introduction. 2. The students do activities follow the teacher's instruction and textbook based on the inquiry method. 3. The student discusses the answer of a crossword. 4. The teacher and student discuss and concluded together in the class. 5. The teacher evaluates the answer.

Based on Table 3. The Analysis fact, concept, and principle can determine the step of guided inquiry method learning combine crossword are; (1) The teacher shows up the problems and phenomena of optical instruments in life. (2) The students understand the phenomenon. (3) The student connected the observation result by learning the teacher's textbook has given before. (4) The student does crossword by the group for finding the concept associated with theory in the textbook. (5) The student formulates by the group about anything that associated theory in the textbook.

(6) The student and teacher discuss and conclude the final result together. (7) The teachers present finding from the student in front of the class randomly.

Optical devices are more comfortable and more enjoyable to study through experiments and crossword methods. This is because of that method easier to present facts and concepts of Optical devices theory.

Results of Design Stage

The design stage was the advanced stage after the define stage. The approach chosen in this study was an inquiry-based learning model assisted by crossword puzzles. The reason for choosing an inquiry-based learning model was a crossword puzzle because the inquiry-based learning model was following the thinking needs of students who were active in learning so that learning outcomes were optimal. Also, the inquiry learning model sharpened the scientific mindset of students who were critical, creative, and independent so that it develops. This observation came from the phenomena or experiences in everyday life and then connected with the physical concept learned in school through an experiment and teaching materials.

Syllabus

The syllabus was designed to contain the identity of subjects consisting of school, grade/semester, subjects, competency standards, essential competencies, and time allocation. The syllabus curriculum consisted of subject matter, learning activities, achievement indicators, assessment, time allocation, and resources/tools/materials. The principal of the syllabus consisted of the eye as an optical instrument; camera and loop; microscope, binoculars, and periscope. The designed syllabus is adjusted to the steps of the inquiry approach assisted by crossword puzzles. Learning activities included components of inquiry, indicators of achievement of competencies consisting of cognitive, affective, and psychomotor indicators. The designed syllabus could be used as a reference in the development of a lesson plan.

Lesson plan

The lesson plan was a guide for teachers in implementing learning; the lesson plan was prepared following Minister of National Education Regulation No. 41 of 2007 concerning process standards. The lesson plan design was adjusted to the learning steps that used inquiry

learning models. The lesson plan was designed to consist of 3 lesson plans with three meetings according to the breadth of the subject matter and the time allocation for each meeting. The allocation of learning activities for one meeting was 2 x 40 minutes. Based on the consideration of the determination of the time allocation in general, students had sufficient knowledge base, the material was not too broad, and the concept was easy to understand.

Teaching Material

Data analysis of the observation of the implementation of the lesson plan obtained was taken from the observation sheet of the implementation of the lesson plan implementation from two observers at each meeting. The accuracy of the implementation plan for lessons I, II, and III is in the convenient category both from the aspect of content feasibility, construction, language, and implementation of learning, which has an average implementation of learning plan implementation of 96.43%. The implementation of learning using learning tools based on inquiry learning models assisted by crossword puzzles on the material of optical instruments is a convenient category, and the overall indicators contained in the lesson plan are carried out according to plan.

A questionnaire teacher response is given to find out the teacher's response to the learning tools that have been prepared — a questionnaire filled by two physics teachers. Questionnaires compiled consist of practice sheets for syllabus, lesson plans, and teaching materials. The teacher's assessment of learning devices based on inquiry learning models assisted with crossword puzzles on the material of optical instruments is efficient both syllabus, lesson plan, and teaching materials with an average of 93.04%. Respondents considered that the device developed could facilitate teachers in delivering magnifying glass material.

A questionnaire for student responses is given to students to find out the practicality of teaching materials. Analysis of data obtained from each student's response to teaching materials. The analysis of students' responses to teaching materials developed is in a very practical category. It can be seen from the average percentage obtained in the use of teaching materials is 82.00%. This shows that learning devices based on inquiry learning models assisted by crossword puzzles on the material of optical instruments developed are efficient to use in learning.

Results of Development Stage

This stage aimed to produce teaching materials for optical devices in inquiry-based learning models with the help of valid, practical, and effective crossword puzzles that were suitable for use in the learning process. The results of the validator's evaluation of the validation sheet consisted of 5 validators; they were 2 Physics lecturers, one Indonesian lecturer, one Computer lecturer, and one practitioner from SMPIT Bunayya Padangsidempuan.

The results of the syllabus validation, lesson plan, and teaching materials can be seen in Table 4.

Table 4. The Results of the Syllabus Validation, Lesson Plan and Teaching Materials

Instruments	Value (%)
Syllabus	88.20
Lesson plan	90.22
Teaching Materials	89.66
Average	89.36

Based on Table 4, syllabus validation, lesson plan, and teaching materials with an average value of 89.36% can be concluded that the device is in the interval 81-100 with a correct category.

Practicality data was obtained from the results of the implementation assessment of the lesson plan, questionnaire responses to physics junior high school science teachers' and students' questionnaire responses in grade VIII A SMPIT Bunayya Padangsidempuan on learning devices. The practicality results of teaching materials could be seen in Table 5.

Table 5. Learning Material Practical Results

Practical Data	Value (%)
Implementation of the lesson plan	96.43
Teacher Response Questionnaire	93.04
Student Response Questionnaire	82.00
Average	90.49

Based on Table 5, the average value of the practicality of the teaching material developed was 90.49%. So, it could be concluded that the practicality of teaching materials was at 81- 100 intervals with a convenient category.

After the teaching material is valid and effective, then it can be seen as the effective-

ness of lesson material. The effectiveness data of teaching materials is obtained based on the study of students who are cognitive, psychiatric, and practical. The ability of cognitive learning is obtained by the percentage of randomized 80.44% obtained in meetings I, II, and III of implementing learning plans. The ability of students has an average of 81.50% with the first criterion obtained from the teacher's response questionnaire to find out the teacher's responses to the learning tools that have been prepared. For the ability of mechanics and classic completeness to be 83.06% with the practical results obtained from the respondent given the scholarship to find out the level of teaching material practice. Analysis of data obtained from each response to the teaching material.

Based on the description above, it could be concluded that physics teaching materials based on inquiry learning models assisted by crossword puzzles on the material of optical devices could improve student learning outcomes for those cognitive, affective, and psychomotor domains. This meant that Islamic materials based on crossword-assisted inquiry learning models were effectively used in learning activities.

Defenition Stage

The definition stage was the initial stage in the development of teaching materials, which aimed to define the learning requirements to achieve the learning objectives. At this definition stage, curriculum analysis, student analysis, and material analysis were carried out.

In the curriculum analysis, it was acquired competencies that must be achieved by students in learning. Competencies to be achieved were reflected in the Basic Competency and Competency Standards that were appropriate for the material of optical devices. The standard of competence was to understand the concepts and application of wave vibrations and optics in daily technology products, and the basic competency was to describe optical tools and their application in daily life. Also, from the curriculum analysis, strategies were found that following the curriculum, namely the crossword assisted inquiry learning model.

The student analysis stage was done to find out the problems experienced by students in the learning process, whether at home or school, and identify the characteristics of students, who were very influential in learning. The analysis results of students' students using AUM-PTSDL obtained that most of the students

got experience problems in cognitive abilities, affective abilities, and psychomotor abilities. The results of the students' analysis were very helpful in the success of this teaching material because the results of this analysis were used by the authors to determine the method in developing teaching materials, because the steps that existed in the inquiry learning model could improve students' psychomotor and affective abilities and giving questions in the form of **CROSSED WORD PUZZLE** can improve students' cognitive abilities.

The material analysis was carried out by identifying competency standards and essential competencies under the guidance on the development of learning materials issued by the Ministry of National Education. With the analysis of this material, it could facilitate the writer in synergizing suitable learning models with the development of the teaching materials. The development material was broken down into several materials, which were classified as facts, concepts, principles, and procedures, which would later be developed in syllabi, lesson plan s, and teaching materials.

Design Stage

Teaching materials were designed in accordance with the crossword puzzle assisted inquiry learning model. Teaching materials were made as attractive as possible, starting from the selection of colors, types, and sizes of letters and also the layout and placement of new images that were following the material of optical tools. The language used was excellent and right, so that it was easily understood by students aged between 11-13 years. Teaching materials were arranged systematically so that anyone could use them. After the teaching material was designed, validation of the device was carried out.

Development Stage

The development stage of teaching materials aimed to make the teaching materials that had been designed valid, practical, and useful. According to Rochmad (2012), to determine the quality of the results of the development of models and teaching materials, three criteria were generally needed; they were: validity, practicality, and effectiveness.

The validity of Teaching Materials

The development of teaching materials was something that could support the success of the learning process. Teaching materials

used must be valid and appropriate for use in the learning process. Based on validation data analysis from 5 validators, the syllabus, lesson plans, and teaching materials based on inquiry learning models assisted by crossword puzzles on the material of physics optical devices developed had an average of 89.36 with very valid categories.

Teaching Material Practices

The analysis data observation of learning planning (RPP) implementation was taken from the observation sheet of RPP from two observers in each meeting. The implementation of RPP I, II, and III are inconvenient category both from the aspect of content eligibility, construction, language, and implementation of learning, which has an average implementation of RPP of 96, 43%. The implementation of learning using learning tools based on independent learning models and the problems in the material of optical learning is categorized very practically, and the overall indicators contained in the RPP are carried out according to plan.

The questionnaire teacher response is given to find out the teacher's response to the learning tools that have been prepared — the questionnaire filled by two physics teachers. The questionnaires compiled consist of practice sheets for syllabus, RPP, and teaching material. The teacher's assessment of learning devices is based on learning models independent of the various types of materials that are very practical for syllabus, lesson plans, and teaching materials, with an average of 93.04%. The respondent considered that the device being developed could facilitate the teacher in conveying material.

The questionnaire response will be given to find out the level of practicality of the teaching material. The data analysis is obtained from each response and the teaching material. The analysis of teaching materials is developed with efficient strategies. It can be seen from the average percentage obtained in the use of teaching materials is 82.00%. It shows that learning devices based on inquiry learning models with a crossword puzzle in an optical appliance are efficient in learning.

According to Ardi (2005), physics teaching materials are more effectively used as learning media because the physics teaching materials used are fascinating, easy to use, useful, and practical for teaching physics. The results of the learning process are changes in individual behavior. Individuals will get new, set-

led, functional, positive, and aware behaviors. Changes in behavior as a learning outcome are behaviors as a whole that includes cognitive, affective, and motoric aspects (Santoso, 2010).

Effectiveness of Teaching Materials

The researcher collaborates with physics teachers and counseling in analyzing students. The effectiveness of teaching materials is based on students' abilities during the learning process, which includes the cognitive domain. The results of the students' cognitive ability are obtained from the student worksheet given at each meeting. On cognitive abilities, the percentage of completeness in classical is 80.44 % of the average value of student learning outcomes. The students' affective abilities include practical value. The result of the practical value of students has an average of 81.50% with perfect criteria. Then for psychomotor abilities taken in the activities of students in doing a practicum, which has an average value of 83.06%, which is categorized as very effective.

The results of the students' cognitive at the microscope, binocular, periscope subject, that has a higher cognitive than the optical appliance material, camera, and loop. It can be seen in Table 6.

Table 6. Students' cognitive ability

Class	Average	Passed Student	Failed Student	% Passed
I	77,00	18	5	78,3
II	79,70	21	2	91,3
III	84,60	23	-	100

According to Wagiarti (2016), student activities are all activities carried out by students during the learning process, giving rise to changes in learning behavior. Behavior change can be said as a result of learning, and each student will get a different behavior change depending on the acceptance of the concept absorbed when learning activities. Teacher activity is an activity carried out by the teacher during the learning process. In the learning process, the teacher has the task to provide knowledge, attitudes and values, and skills to students.

According to Sujanto (2009) response or response is defined as a behavior or attitude that is tangible both before detailed understanding, assessment, influence or rejection, like it or not and the use of a particular phenomenon.

CONCLUSION

Based on the results of classical completeness analysis on cognitive, affective, and psychomotor domains, it was found that physics teaching materials based on crossword inquiry assisted models were effective in improving students' abilities.

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