Development of interactive teaching materials with scientific approach contains character values in learning matter about sounds wave, light wave, and optical devices in senior high school class XI

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Abstract. This research intends to produce interactive teaching materials that has been valid and practice tested. The teaching material presents matter of physic with scientific approach contains character values in learning matter about sound wave, light wave, and optical devices. The teaching material is developed as a solution to increase student interest in physics. This research is a research and development (R&D) type that uses Plomp development model. For validity and practicality test this research uses questionnaire instruments. The validity questionnaire instrument is filled by three physics major of FMIPA UNP’s lecturers as the validators. For practicality questionnaire instrument is filled by two teachers and twenty students of SMAN 8 Padang as the practitioners. Finale data of the questionnaire instrument is analyse by using Likert scale. From validity test, the developed interactive teaching material is rated very valid with percentage average score 86.4%. From practicality test, the developed interactive teaching material is rated very practice by teachers and students with percentage average score by teachers 93% and percentage average score by students 82.0%. It means that the developed interactive teaching material is proper to be used in school as learning media.

1. Introduction

Changes in the education system in Indonesia are carried out to achieve the goals of education itself. One of the goals of national education is contained in Act No. 20 Year 2003 which is to educate the lives of the nation. To achieve this goal, education must be able to produce quality Human Resources (HR). Quality human resources (HR) are obtained from quality education. Therefore the government strives to improve the quality of education in Indonesia by providing the best educational facilities and infrastructure.

In addition to providing facilities and infrastructure, the government's efforts are by develop curricula and organize various programs to improve the competence of teachers and other education personnel. In Indonesia, the current curriculum is Curriculum 2013 which is an improvement from the previous curriculum, namely the Education Unit Level Curriculum (KTSP). The 2013 curriculum was developed with the aim of improving and balancing abilities in the form of attitudes, knowledge, and skills [4].
There are 14 main principles of 2013 curriculum learning that teachers need to apply, such as students are expected to find out, teachers are no longer the only source of learning for students, students are no longer learning with a textual approach, learning is no longer based on student learning outcomes, subjects taught to students are no longer partial, learning no longer emphasizes single truths, learning is presented in fact, pictures, videos, or diagrams, skills developed and assessed by students are not just one skill, students are directed as lifelong learners, learning to apply exemplary values (ing ngarso sung tulodo), building willingness (ing madyo mangu karso), and developing students' creativity in the learning process (tut wuri handayani), learning not only utilizes class time, learning apply that anyone is a teacher, anyone is a student, and anywhere is a class, the maximum utilization of information and communication technology (ICT), and learning must pay attention to the differences that exist in each student [3].

2013 curriculum also wants the learning process to use scientific approach. The scientific approach consists of 5 steps, namely observing, asking, trying, reasoning, and communicating. It is mentioned in minister of education and culture regulation No. 22 Year 2016 where the curriculum used to change from that originally textual approach into scientific approach [1].

Physics is subjects that study natural phenomena and their measurements. But not all exist natural phenomena can be observed in plain view. For examples are the phenomenon of light, sound and the formation of shadows on optical devices. This learning matter requires video, image and animation assistance in its presentation. Therefore, physics lessons are often considered difficult by students in schools because of observing the formation of shadows and the course of light on optical devices only through the images in textbooks. To support the achievement of learning with these conditions, the progress of science and technology can be utilized.

One of the uses of science and technology in learning is multimedia. Multimedia is a media that contains video, images, sound, text, and animation. Media that is often used in learning is teaching materials. Teaching materials play an important role in the implementation of the learning process in the classroom. Teaching materials are all forms of materials, information, tools and texts that are used to assist teachers in carrying out learning activities in the classroom and for the design and review of learning implementation. Teaching materials are a set of materials that are systematically arranged both written and not so as to create an atmosphere / environment that allows students to learn [3].

The teaching materials used should be able to stimulate the interaction of students so that students are more active as expected 2013 Curriculum. Therefore it is needed interesting and easy-to-understand teaching materials in order to change students' assumptions that physics learning is difficult in the form of interactive teaching materials.

Interactive teaching material is an independent learning package which includes a series of learning experiences that are planned and designed systematically to help students achieve learning goals. Teaching material is a format of material given to students. This format can be linked to certain media, handouts or textbooks, games and so on [6].

Interactive teaching materials made with multimedia technology. Multimedia is the use of computers to create and combine text, graphics, audio, moving images (video and animation) by combining links and tools that allow users to navigate, interact, create and communicate. Based on the advantages of multimedia technology, students not only hear (involve the sense of hearing) but also see (involves the sense of sight). The more senses used to receive and process information, the more likely the information is understood and can be maintained in memory [1].

In addition to achieving competency in knowledge and skills, the 2013 Curriculum also requires the achievement of spiritual attitudes and social attitudes. The achievement of these aspects can be seen from the character values possessed by students. Therefore learning must be associated with character values. Character is a description of a person's behavior that reflects the values of life and is inherent in a person. People with character have various dimensions such as social, physical, emotional, and academic dimensions [8].

Character education is very important because of the declining ethics, morality of students, and increasingly rampant student delinquency. Character education in schools basically has the purpose of
empowering people who are strong, competitive, noble, moral, intolerant, cooperating, patriotic, developing dynamically, oriented to science and technology inspired by faith and piety to God Almighty and based on Pancasila\(^2\). Students are expected to be religious, honest, responsible, disciplined, hard working, confident, noble, capable, and creative. Evaluation of students' character values can be done by referring to several indicators that have been made. In addition, the evaluation of character values can also be done with each student's behavior\(^9\).

Reality in the field is often not as desired according to the 2013 curriculum. Where after observing 32 students in class XI at SMAN 8 Padang in the academic year 2017/2018, it was found that as many as 100% of students stated the teaching materials used in physics learning were printed teaching materials and only 8% stated that the teaching materials were interesting and not boring. In the aspect of character, students tend to be less careful and lack confidence in their own abilities, whereas 90% of students are able to work together in groups. But the scientific approach during the learning process has been implemented but not fully.

The problems described above can be overcome with interactive teaching materials with a scientific approach that contains character values, so that the teaching process is more effective. Even students will become active and have good character values. Therefore, based on this background, the authors are interested in conducting research entitled "Development of Interactive Teaching Materials with a Scientific Approach Contained Character Values in Sound Wave Materials, Light Waves, and Optical Instruments in Class XI SMA / MA". This teaching material is created using software Microsoft PowerPoint 2013 which can design and make presentations more interesting and professional\(^11\).

2. Research Method
Type of research used during this research is research and development (R&D) where R & D is a research method used to produce a particular product, and test the effectiveness of the product\(^10\). The products that will be produced in this study are interactive teaching materials with a scientific approach containing character values in the material of sound waves, light waves, and optical devices in class XI SMA / MA.

The stages of research carried out on the development of interactive teaching materials are guided by the development steps revealed by Plomp. The Plomp development model consists of five phases, namely: 1) preliminary investigation phase, 2) design phase, 3) phase of realization / construction, 4) phase of testing, evaluation and revision, and 5) implementation \(^7\). In this research the development of interactive teaching materials uses 4 of the 5 phases. Limitation in research procedures caused by time constraints.

In the first phase is the preliminary investigation phase. The term ‘preliminary investigation’ can also be called needs analysis or problem analysis\(^7\). This first phase aims to find problems in learning physics at school. The initial investigation phase conducted in this study began by distributing observation questionnaires to students in SMAN 8 Padang.

In the second phase is the phase of design aims to set the framework of interactive teaching materials as a solution to the problem has been found in the initial investigation phase. characteristic of the design phase is the reduction of all alternative solutions to problems and comparing and evaluating these solutions by producing the best design or framework choices as the solution\(^7\).

The third phase of the development model of Plomp is the phase of realization/construction where the frame/design of interactive teaching materials that have been designed in the previous phase will be realized or produced in this phase. design is a work plan that will be realized in the phase of realization / construction in order to obtain solutions to existing problems\(^7\).

In the final phase in the development of this interactive teaching material, the test, evaluation and revision phases aim to produce valid and practical interactive teaching materials. Without evaluation, it cannot be determined whether a problem has been solved satisfactorily. Based on the results of the test data, it will be able to determine which problem that still needs to be fixed so that the problem solving as desired.
To determine the level of validity and practicality of interactive teaching materials that have been made use validity test and practicality test. Validity test was carried out with the aim to examine the substance validity, appearance, components of interactive teaching materials, software utilization, and characteristics of interactive teaching materials that have been made by 3 validators namely the Physics Department FMIPA UNP lecturer. Interactive teaching materials that will be tested are given to the validators who then analyzed their validity using an instrument in the form of a validity questionnaire. The response from the validator in the form of criticism, input, and suggestions is used as a basis for revising the interactive teaching materials that have been made.

In addition to validity testing, practicality tests were also carried out. Practicality test is carried out to determine the practicality of interactive teaching materials that will be used by teachers and students. The indicators that will be used to express the practicality of active teaching materials are the completeness of interactive teaching materials, the scope of interactive teaching materials, the presentation of interactive teaching materials, the benefits of interactive teaching materials, and the opportunities for interactive teaching materials to be implemented in schools. Instrument in the form of questionnaire practicality test is filled by teachers and students in SMAN 8 Padang.

Analysis of the data used in this study uses a Likert scale. On a Likert scale, the variables to be measured are translated into indicators that can be measured and made in the form of questions or statements that need to be answered by the respondent. In determining the value of validity and practicality by means of

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Validity/practicality \text{ score} = \frac{\text{total score obtained}}{\text{total maximum score}} \times 100\%
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3. Research Results and Discussion

3.1. Research Results
The results of the research carried out include interactive teaching materials with a scientific approach containing character values which are declared to be valid and practical. The results of the products made have the following specifications:
Interactive teaching materials are made using Microsoft Powerpoint 2010 and Macromedia Flash applications which are then converted into flash forms using the iSpring Suite 8 application. Interactive teaching materials with scientific approaches and character values consist of several components, namely: menu lists, KI, KD, indicators, learning objectives, physics matter presented with steps of the scientific approach, character values developed in interactive teaching materials, sample questions, evaluation questions, and LKS. Teaching materials are also inserted in several videos, animations, pictures, narratives, and music to make it more interesting to be used by students. The opening page display contains a welcome greeting, the title of the material contained in interactive teaching materials, the UNP logo, the name of the researcher and the SIN, the name of the Physics Department of FMIPA UNP, as well as some images related to the material. The writing used is the type of Calibri and Footlight MT Light with added effects to make it look more attractive. Then the final animation effect shows a button that says "GO" which is used to start interactive teaching materials. The opening page view of interactive teaching material is presented as in Figure 1 below.

Figure 1. Opening page display.
The menu list display contains the page title and several menus that can be selected, namely: concept map menu, syllabus menu, instructions menu, material menu, LKS menu, and evaluation menu. The menu list page display is presented as in Figure 2 below.

![Figure 2. menu list page display.](image)

Next on the concept map page on interactive teaching materials containing submersion which will be discussed in interactive teaching materials. The view of concept map page is presented as in Figure 3 below.

![Figure 3. The page of concept map display.](image)

Interactive teaching materials also have a syllabus page that contains the content contained in the syllabus, namely: core competencies, basic competencies, indicators, and learning objectives. The display of the syllabus page is presented as in Figure 4.

![Figure 4. Display of the syllabus.](image)

The instruction page created in the interactive teaching material contains instructions for the teacher, for students, and the use of interactive teaching materials. The display of the instruction page for teachers in interactive teaching materials is presented as in Figure 5 below.
Figure 5. Display of instruction for teacher.

The first page contains a list of what materials will be discussed in the teaching material. The list of materials is supported by images related to each material and can be suppressed. The page view of the material is presented as in Figure 6 below.

Figure 6. Display of learning matter pages.

Page displayed after selecting material is presenting material with steps of the scientific approach. The steps presented are 5M (Observing, Asking, Collecting information, Reasoning, Communicating). The page view step of the scientific approach is presented as in Figure 7.
After completing listening to the material presented, students will be given examples of problems and their solutions. The page display sample questions as shown in Figure 8 below.
Page character values contained in the material contain character values that can be extracted by students from the material presented. The page display of character values is presented as in Figure 9 below.

The LKS page contains activity sheets for students using a simulation of the sound characteristics of Vlab. The activities carried out by students in the practicum are observing the relationship of frequencies with sound wavelengths, sound wave propagation, and sound intensity. The page display of character values is presented as in Figure 10 below.

After interactive teaching materials are developed, validity tests and practicality tests are carried out. The results of the validity tests carried out have been described in the previous journals which are published in the journal Pillar of Physics Education Volume 11 Number 2, 2018. The results of the validity test are obtained that the percentage value is 86.4% with the criteria of using a Likert scale is very valid.

Practicality test aims to determine the level of practicality of interactive teaching materials developed using the instrument in the form of practical questionnaire. The practicality questionnaire
was filled by 2 practitioners from the physics teacher of SMAN 8 Padang and 20 practitioners from students of SMAN 8 Padang.

In summary, the results of the practicality tests conducted by the teacher are presented in Table 1 below.

| No | aspect of assessment                                | Practicality percentage | Criteria      |
|----|----------------------------------------------------|-------------------------|---------------|
| 1  | Completeness of interactive teaching materials     | 93.3%                   | Very practical|
| 2  | Coverage of interactive teaching materials         | 87.5%                   | Very practical|
| 3  | Presentation of interactive teaching materials     | 95.7%                   | Very practical|
| 4  | Benefits of interactive teaching materials         | 93.3%                   | Very practical|
| 5  | Implementation opportunities interactive teaching materials | 95.0%                   | Very practical|
|    | Average                                            | 93.0%                   | Very practical|

In addition to teachers, students also carry out practicality level tests of interactive teaching materials developed. In summary, the results of the practicality tests conducted by students are presented in Table 2 below.

| No | aspect of assessment                                | Practical percentages | Criteria      |
|----|----------------------------------------------------|-----------------------|---------------|
| 1  | Ease of user guide                                 | 82.0%                 | Very practical|
| 2  | Ease of understanding the material                 | 83.1%                 | Very practical|
| 3  | Implementation of teaching materials               | 80.8%                 | Practical     |
|    | Average                                            | 82.0%                 | Very practical|

Based on the table, the results of the practicality test is that the percentage value in the assessment aspect, the ease of the user guide is 82.0% with the criteria of using a Likert scale is very practical. That way, from the results of the validity test and practicality test that has been carried out interactive teaching materials can be stated to be in the category of very valid and has entered the category of very practical.

3.2. Discussion

The results obtained from the data analysis show that the interactive teaching material developed has a percentage of the average value of validity of 86.4% with very valid criteria. This means that interactive teaching materials can be used as learning media as well as learning resources in accordance with the demands of the 2013 curriculum[5].

Practical test of interactive teaching materials is carried out by two teachers of SMAN 8 Padang. The results obtained from the data analysis showed that the interactive teaching materials developed obtained a percentage of the average practicality value of 93.0%. By using a Likert scale it was stated that the interactive teaching materials developed had met very practical criteria. The results of the practicality analysis conducted by the teacher are presented in Figure 11 below.
Based on aspects of the assessment of completeness, interactive teaching materials have been declared very practical by the teacher with a percentage of 93.3%. This can mean that interactive teaching materials have user instructions that are easy to understand and are considered to present material that is in accordance with the indicators.

Based on the aspect of coverage assessment, interactive teaching materials get an average percentage of values of 87.5% with very practical criteria. This can mean that interactive teaching materials contain dimensions of knowledge that are relevant to the indicators and contain steps of the correct scientific approach.

Based on the aspect of assessment presentation, interactive teaching materials get an average percentage value of 95.7% with very practical criteria. This can mean that interactive teaching materials have provided complete components of teaching materials and have a look that is considered attractive.

Based on the practicality test on the aspect of benefit assessment, interactive teaching materials get an average value of 93.3% and are categorized as very practical. This shows that the teacher considers interactive teaching materials can make learning interactive and easier to understand by students.

Based on the practicality test on the aspect of implementation opportunity evaluation, interactive teaching materials get an average value of 95.0% and are categorized as very practical. This shows that interactive teaching materials are considered to be used by teachers as learning media and can help students to master the material.

In addition to teachers, students are also given practicality instruments to determine the level of practicality by students. The results obtained from the data analysis show that the interactive teaching material developed has an average percentage of practical value of 82.0%. By using a Likert scale it can be stated that the interactive teaching material developed has met very practical criteria. The results of the practicality test analysis conducted by the participants are presented in Figure 12 below.
Based on the assessment aspects of ease of user guide, interactive teaching materials have been stated to be very practical by students with a percentage of 82.0%. This can mean that interactive teaching materials have clear guidelines and instructions and can make it easier for students to use interactive teaching materials that are made.

Based on the assessment aspect, the ease of understanding the material, interactive teaching materials get an average percentage of values of 83.1% with very practical criteria. This can mean that interactive teaching materials are considered to make learning more interesting and easy to understand, can be used anywhere and help students' understanding of the material.

Based on the aspects of implementation assessment, interactive teaching materials get an average percentage of values of 80.8% with practical criteria. This can mean that interactive teaching materials are considered to help students understand the material independently and make learning time more efficient and effective.

The results of the analysis of the practicality test by the teacher and students which have been translated into evidence that the interactive teaching material developed has fulfilled the aspects of assessment in the practicality tests carried out. This means that the interactive teaching material developed is declared practical to be used as a learning medium by the teacher and as a learning resource for students.

During this research found several obstacles encountered during the research activities. The constraints include problems in running the Ispring Suite 8 application that has a large capacity so that the laptops that are used often experience errors. In addition, it is due to the frequent occurrence of errors in the laptop that is used so that the product that is done is not stored. But in the end the development of interactive teaching materials can be completed by producing interactive teaching materials with a scientific approach containing character values on the material of sound waves, light waves, and optical devices that have been tested for validity and practicality and declared valid and practical.

4. Conclusion

Based on the research that has been carried out interactive teaching materials with a scientific approach containing the character values developed have been through validity tests with results in the very valid category of five aspects of assessment with percentage of the average value of validity test results of 86.4%. And has been through a practicality test with results in the very practical category by the teacher with the percentage of the average value of the validity test results of 93.0% and very practical categories by students with a percentage of the average value of the validity test results of 82.0%.

Based on the research that has been done, the researchers suggest that teachers can use interactive teaching materials with a scientific approach containing character values as one solution to increase students' interest in learning physics and meet the demands of the 2013 curriculum that wants students to be interactive and have values character value.

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