The Development of Instructional Multimedia based on Science, Environment, Technology, and Society (SETS)

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Abstract. This research aims to produce a valid and practical SETS-based instructional multimedia for natural science course to seventh-grade students associated with media worthiness criteria. This study applied research and development methodology with 4-D Model which comprises of four-stage procedure accordingly, such as: define, design, develop, and disseminate. Three experts engaged with the product validation process with two media experts and one material expert. Meanwhile, 22 students of MTs PP Muallimin Muhammadiyah Sawah Dangka, Regency of Agam involved in the product trial examination. To collect the data, the researchers used interview, questionnaire and documentation archives which were analyzed with a descriptive qualitative method. The result found that in the initial step, the researchers defined the instructional media integrated with science, environment, technology in the learning. In the development stage, it was conducted the incorporation of various instructional tools, such as learning video and animation. Meanwhile, in the phase of worthiness assessment from material and media experts, it was obtained the material validity around 85.67% with ‘Very Good’ category so that the material was declared valid for use. Furthermore, through two steps of media validation, it was found that the final value of validator 1 and 2 were 92.93% and 81.09% consecutively with the category "Very Good" so that the media was valid to be tested. It can be concluded that SETS-based learning multimedia is worth testing. Furthermore, the results of the analysis based on the testing of SETS-based multimedia product learning in students received an average score of 93% in the "Very Practical" category. These results indicate that SETS-based learning multimedia products (Science, Environment, Technology, and society) are worthy of being used as an alternative learning media in class VII SMP / MTs (junior high schools) for natural sciences subject.

Keywords: Learning Media, SETS, Natural Sciences, Middle School

1. Introduction

Learning media are an inseparable part of learning because the urgency of media is a mean for an effective message delivery. Natural sciences course requires interesting media to explain the concept of learning effectively [1]. The advancement of information and communication technology requires the learning process also adjusts to the needs of the community and is also relevant to the progress of the times. Natural sciences subject is synonymous with integrating technology into learning [2].
Science and technology are not separate from each other but go altogether, and the ability to master technology is a reflection of the nation development. Technological developments also arrives in the education world, especially in the development of learning media. The development of technology in learning media can simplify the process of delivering messages, namely subject matter from educators to students to achieve learning goals or competencies that have been set.

Hamalik [3] suggests that "the use of learning media in the teaching and learning process can arouse desire, interest, motivation, and stimulation of learning activities, and bring psychological effects to students." The use of appropriate learning media at the learning orientation stage will greatly help the effectiveness of the learning process and the delivery of messages and content of learning at that time. In addition to arise students’ motivation and interest, learning media can also help improve understanding, present data in an interesting and reliable way, and can help change abstracts that can be concretized and can make learning environments that are not interesting to be interesting. One function of learning media is to connect messages. The phenomenon observed in the learning of Natural Sciences in junior high school. This material is interesting because it deals with the whole universe, objects that exist on the surface of the earth, the environment, in the bowels of the earth and beyond space, both those that can be observed by the senses and cannot, and all that are related to human life and humans and natural phenomena it faces. The results of observations in science subjects generally still tend to be conceptual. The material is still presented conventionally which is still oriented towards conveying concepts orally. Even though according to the competencies desired in science learning, ideal learning is carried out with the concept of planting patterns and implementation. This phenomenon can be seen in science learning at MTs PP Muallimin Muhammadiyah Sawah Dangka about the form of substance and its changes, learning is still conducted with the teacher explaining the material, even though the material requires a process, it is not enough just to explain. Teachers tend to only use images in textbooks for example and students only learn the material, whereas process lessons will be more easily understood by direct involvement or direct observation, especially for the material which can be related to everyday events both in the environment and the community can facilitate students in understanding, because they are given examples that they might be able to feel.

The results of teacher interviews indicate that the process of learning science that has taken place so far only uses simple media and does not support the achievement of expected learning goals and competencies. The results of the study show that information and communication technology-based learning media increase students’ tendency to learn because it functions to make the message more concrete [4]. Natural science subject requires students to are able to think critically and logically, in connection with this, the use of learning media facilitates the achievement of student competence in learning. In associated with this, learning media are necessary to be integrated in natural science learning [5]. The use of media in the delivery of messages or learning material that aims so that the message or learning material is received optimally by students who have different modalities [6].

In this regard, learning media are needed to integrate text, images, animations, and videos through electronic devices in the form of computers. The use of these variations in the learning process is expected to be able to increase motivation, enthusiasm, and desire of students for more optimal learning, and is expected to increase students’ curiosity to learn the subject matter. In addition, multimedia students can learn independently, so students who are a little slow understanding of material can repeat learning matter. The learning material is made by expressing science, technology, and society in learning known as science, environment, technology, and society (SETS).

SETS-based natural science learning means loading the learning of science, environment, technology, and society in each discussion of the material because the tendency of the material is interconnected and relevant. Learning material is associated with real examples related to the community around students that are often found in everyday life, so it is easy to understand the material. The existence of SETS in learning is expected to be obtained by thinking about the form of technology from the transformation of science produced without having to damage the environment and society. Ahmad Binadja [7] argues that through SETS education it is expected that students will have the ability to look at things integrally by paying attention to the four elements of SETS so that a deeper understanding of the knowledge they have can be obtained [8].
In general, SETS in learning has two characteristics, namely learning based on actual problems and learning that links the four elements of SETS, namely science, environment, technology, and society. In science study fields, materials that can be taught with SETS are materials which can be linked to these four elements. One of the examples of science materials that can be taught is the form of matter and its changes that often found in daily life.

The development of SETS-based multimedia learning in science subjects is in line with Minister of National Education Number 16 of 2007 concerning Academic Qualification Standards Teacher Competence which states that science teachers in junior high schools must have the competence to apply the concepts, laws, and theories of science in everyday life. In addition, teachers must also be able to follow technological developments in education to improve science learning in the classroom [9].

The development of this learning multimedia uses Macromedia director software. Macromedia director is one of the software to create interactive multimedia programs, the advantages of which can display high-quality image, animation and video images. This software can also combine many multimedia software, word processing, data processing or web-based software [10].

2. Method
This type of research is development research (Research and Development). The development of this learning multimedia uses the 4D model which includes 4 stages, namely the stage of defining, designing, developing and disseminating.

The data sources in this study were 22 students of MTs PP Muallimin Muhammadiyah Sawah Dangka, Regency of Agam. In addition, in the test phase validity was carried out by 3 people. Two media validators came from the Curriculum and Technology Education Department and one science teacher as a material validator.

The SETS-based multimedia development design steps are presented as follows:
1. Define. The purpose of this stage is to define and define learning conditions. This stage includes 4 main steps, namely: (a) analysis of the SMP / MTs curriculum, (b) student analysis, (c) concept analysis, and (d) formulation of learning objectives.
2. Design. At this stage, flowcharts and storyboards are created as an illustration of the multimedia that will be created. The material presented is adjusted to basic competencies and is associated with SETS.
3. Development. This stage includes a validity and practicality test. Validators who validate are people who are competent in their fields, namely material validators and media validators. Inputs and suggestions, as well as criticism from the validator are used as material to revise and improve the multimedia that has been made. Practicality is carried out to determine the extent of the impact and ease of use and the practicality of multimedia learning by students.
4. Disseminate. The dissemination stage is carried out to promote development products so that they can be accepted by users, whether individuals, groups, or systems.

The data collection instruments used were documentation, interviews, questionnaires, and documentation. Data analysis techniques used were descriptive statistical techniques. This technique will describe the results of validity tests, the practicalities of SETS-based multimedia learning.

3. Results and Discussion
The stages of developing learning media begin with the stages of curriculum analysis. Curriculum analysis is used as a consideration and guideline in making SETS-based multimedia learning. The material developed comes from the competency standard, which is to understand the form of matter and its changes and its basic competency is conducting experiments related to expansion in everyday life. The indicators presented in multimedia learning are (1) Investigating the process of expansion of solid, liquid, and gas objects, (2) Showing expansion of solid, liquid and gas objects, (3) Investigating differences in the volume expansion of various types of liquids, (4) Demonstrate the principle of
expansion in technology such as bimetal for thermostats, welding, installation of iron frames on wheels, installation of glass.

The next stage is the results of student analysis relating to the conditions and characteristics of students. Students are interested in innovative media with many variations of images, videos, and animations as well as coloured media. Students also like to see examples of material that is learned because it can be easily understood and fast.

Conceptual analysis is used to identify, detail and systematically arrange the concepts to be taught. The concept taught from multimedia is to connect the knowledge of the concept of expansion with what technology uses the principle of expansion so that the technology can be useful to the community and what impact is felt due to the expansion process.

The design phase includes making flowcharts and storyboards. The flowchart is used to help design multimedia SETS-based learning. The results of the design stage in the form of a flowchart can be seen in appendix 1. The storyboard is a more detailed/complete explanation of each plot contained in the flowchart. For more details, the storyboard can be seen in appendix 2.

The development stage is carried out by making multimedia learning, validity testing and practicality testing on multimedia that has been developed. Based on the research that has been done obtained data about the percentage of multimedia feasibility from the material, media, and practical aspects. The results of the percentage of validity and practicality of multimedia are included in the excellent category. The following are the results of SETS-based multimedia learning validation:

Table 1. The average percentage of media validation assessment

| No | Validated aspects  | Score | Percentage | Average | Category      |
|----|-------------------|-------|------------|---------|---------------|
|    |                   | 1     | 2          | 1      | 2             |               |
| 1  | Language          | 14    | 12         | 93.33% | 80%           | 86.7% Very Valid |
| 2  | Layer Display     | 13    | 12         | 86.7%  | 80%           | 83.3% Very Valid |
| 3  | Suitability       | 53    | 47         | 96.4%  | 85.5%         | 90.9% Very Valid |
| 4  | Easiness          | 14    | 12         | 93.3%  | 80%           | 86.7% Very Valid |
| 5  | The Overall display | 19    | 16         | 95%    | 80%           | 87.5% Very Valid |
|    | **Average**       | 16    | 14         | 95%    | 80%           | 87% Very Valid  |

The results of evaluations by the validator on the media developed about the media aspect obtained an average value of 87 %. Based on the criteria contained in the validity analysis of aspects of the media, it was concluded that the multimedia produced was in a very valid category. It is meant that the media developed could be used as a learning medium after minor revisions.

Table 2. The average percentage of material validation assessment

| No | Validated aspects | Score | Percentage | Category                        |
|----|-------------------|-------|------------|---------------------------------|
| 1  | Language          | 17    | 85%        | Very Valid                      |
| 2  | Layer display     | 23    | 92%        | Very Valid                      |
| 3  | Suitability       | 30    | 85.7%      | Very Valid with minor revision  |
| 4  | Easiness          | 12    | 80%        | Very Valid                      |
|    | **Average percentage** |     | **85.7%** | Very Valid                      |

The results of the validator's assessment of multimedia developed were seen from the material aspects obtained an average value of 85.7%. Based on the criteria contained in the validity analysis of the material aspects, it was concluded that the multimedia produced was in a very valid category. This means that the media developed can be used as learning media after minor revisions.

Table 3. The Average percentage of the students’ practicality assessment
The student's assessment of developed multimedia obtained an average value of 92.7%. Based on aspects of ease of use, attractiveness, understanding of concepts and questions, the resulting multimedia received a positive response for students and was in a very practical category.

The last stage in this development is the dissemination stage. At this stage, the author is only able to provide one multimedia learning CD to the science teacher. This is due to the limited cost of the author to multiply the multimedia developed. In addition, the author also packs and presents the results of SETS-based science learning multimedia product development in the form of scientific work [11]. SETS-based learning allows students to integrate the knowledge acquired with real situations in the field so that learning can be contextual.

SETS-based learning multimedia is an important medium for science learning because it can improve students' understanding of learning material. SETS-based learning media is a media that integrates technology, environment and social learning. Multimedia is important because the learning process that integrates with the social and community environment will make learning more meaningful for students [8].

The development of multimedia learning is done through 4 stages called 4D (define, design, development, and disseminate). Macromedia Director MX 2004 was the main application that researchers used in making this learning multimedia with the help of supporting applications namely Photoshop CS 4, Ulead Photostudio, Cool Edit Pro 2.1 and Macromedia Flash [12].

Multimedia learning developed was used as a learning media by using computers as devices. Therefore, using computers in learning is expected to motivate students to be able to learn actively and independently. As explained by "computer-based interactive learning programs have more value, compared to ordinary printed learning materials. Interactive learning is able to enable students to learn with high motivation because of their interest in multimedia systems that are able to present the appearance of text, images, videos, sound and animation [13].

In general, the benefits that can be obtained through the use of interactive multimedia is that the learning process is more interesting, more interactive, the amount of teaching time can be reduced, the learning quality of students can be improved and the teaching and learning process can be done at any time, and students' learning attitudes can be improved [12].

This is in accordance with the initial objectives of product development, namely to create interactive learning anytime and anywhere, so that students can learn independently there or no teacher. Media carefully designed learning can make independent learning more effective. As also explained that "the media are not only used by teachers but more importantly can be used by students [5]. Therefore, as a presenter and message provider in certain matters the media can represent the teacher to convey information more thoroughly, clearly and interestingly. These functions can be carried out well even without the presence of a physical teacher. "

Multimedia learning developed is SETS-based, meaning in multimedia learning integrated SETS values namely science, Environment, Technology, Society. SETS-based learning guides students to associate science concepts with other elements in SETS. This method allows students to get a clearer
picture of the relevance of the concept with other elements in SETS, both in the form of advantages or disadvantages Binadja in [14].

SETS-based learning is expected: (1) Students are used to having a comprehensive (comprehensive) mindset in looking at material in science subjects as a science that is integrated with the environment, technology, and society [15]. (2) SETS can make students know that technology affects the rate of growth of science, and its impact on the environment and society. (3) Through SETS, students are expected to be more interested in learning material because it is associated with real things in everyday life, so as to gain a deep understanding of the knowledge they have [16].

SETS-based learning can already be applied to students who sit in junior high school because it fits Bloom's opinion that the affective aspects of junior high school students are:

1. Be aware of situations, phenomena and society & objects around them.
2. Responsive to the stimulus that is around students.
3. Able to judge.
4. Already able to organize values in a system and determine the relationship between the values that exist.
5. It has begun to have characteristics and know these characters.

The multimedia learning developed will then be assessed for its feasibility before it is applied at school. Assessment of multimedia feasibility of learning is obtained from media experts and material experts and responses from students. Assessment is carried out to get suggestions, comments, and data which will then be improved. The process is carried out in order to produce learning multimedia that is feasible to use and useful for users. Validation or assessment by experts on multimedia learning is divided into 2 parts, namely media and material. The media section includes 5 aspects, the first aspect is linguistic with 3 indicators, namely the language used in accordance with the rules of Indonesian grammar, the language used is in accordance with the thinking level of class VII junior high school students and the writing used can be read clearly. All indicators are highly validated by the two media experts. According to Asyar [17] "one of the criteria for multimedia is narration or language must be clear and easily understood by students. The use of the term needs to be adapted to media users so that learning can be effective.

The second aspect is the display aspect of the screen design with 3 indicators, namely the font size used accordingly, the type used according to the composition of the writing color with the appropriate background colour. All indicators are also highly validated by the two media experts. Sumiati [18] argues that one of the requirements for learning media is a factor of beauty (aesthetics) which includes: its aesthetic shape, harmonious size and right with attractive color combinations so that it attracts the attention and interest of students to use it.

The third aspect is the suitability of the media with 11 indicators, among others, the image displayed is clear, the image used makes it easy to understand the contents of the learning material, the video is displayed according to the context, the video placement is correct, the video displayed is clear, the video used makes it easy to understand learning material, proper button layout, navigation buttons function properly, and media pages do not confuse users. Both media experts consider it very valid. This aspect is supported by the opinion of Sumiati [18] that learning media must fulfill the element of truth in size, accuracy, and clarity to avoid misunderstanding of something that is described or explained through the learning media.

The fourth aspect is ease of use with 3 indicators, namely the material in multimedia learning is presented in a systematic/systematic way, multimedia learning is easy to use, instructions for using the program are clear / not confusing and both media experts assess very well. Sumiati [18] says learning media must easy to use both by the teacher and by the students. The last aspect is the overall display of multimedia both from the use of colour, font size, font type and the information delivered are considered very valid by both media experts.

Validation or assessment by experts on multimedia learning is then part of the material which consists of 4 aspects. The first aspect is the content/material aspect which consists of 4 indicators, namely the material presented in accordance with competency standards, the material presented in accordance with basic competencies, the material presented in accordance with the indicators, and the
material presented according to the needs of teaching materials. Appraisal material experts are very valid.

Asyar [17] states that learning media must be in accordance with the learning objectives, characteristics of students and the material being studied, as well as methods or learning experiences provided to students. Sumiati [18] also revealed that learning media must be in accordance with the objectives and learning materials listed in the lines of learning programs that have been determined in the curriculum applied in the school [19].

The second aspect is a language with 5 indicators, the writing used can be read clearly, the language used is in accordance with the rules of Indonesian language, the language used is not confusing, the language used supports the ease of understanding the material and how to use the media clearly. The third aspect is the presentation with 7 indicators, namely the material presented is described in a coherent manner, the material presented is complete, the sample used is relevant to the material, the example used makes it easy to understand the material, the evaluation can measure students' abilities, the answer key is correct and accordingly, there are instructions before conducting an evaluation. The last aspect is the appearance of media with 3 indicators, namely the design of attractive media display, proper media layout, examples, pictures, or videos that are used appropriately. All indicators are considered by material experts to be very valid.

Multimedia SETS-based learning in science subjects has been carried out by media expert validation tests involving 2 media experts, namely lecturers of the Universitas Negeri Padang. The results of the assessment data by the validator show that interactive learning multimedia is categorized very well with a value of 87% which results are obtained from questionnaires and suggestions provided by media experts on multimedia learning made. Based on suggestions and input from media experts, the product is then repaired/revised. The development of SETS-based learning media integrates various media, videos and learning materials and is designed based on problems. In this case, the students will be given learning material integrated with science and technology [20]. After validation, the practicality test is carried out by students. Practical tests cover 6 aspects, namely ease of use instructions, ease of use of menus, use of multimedia, attraction, evaluation/test, and learning motivation of students.

Multimedia practicality is related to the practicality of the use of media developed. After validation, practical tests are carried out by students. Multimedia practicality is related to the practicality of using the developed media. Practical tests were obtained from questionnaires given to 22 students of class VII MTs PP Muallimin Muhammadiyah Sawah Dangka. Multimedia learning is categorized as very good/very practical with a value of 93%.

Based on the explanation above, SETS-based learning multimedia products in can be categorized as valid for seventh-grade students of natural science learning and can be used as an alternative in selecting learning media that will be used for teaching and learning. SETS-based multimedia learning can stimulate students to think critically and be able to observe environmental phenomena around them and link them to learning [21].

4. Conclusion

Based on the results of the research and discussion that has been done, it can be concluded that: 1) The development of SETS-based multimedia learning in science class VII SMP / MTs was declared very valid by both media experts with the results of validator 1 giving an assessment of 92.9% and validator 2 giving 81.1% assessment. SETS-based multimedia learning in class VII SMP / MTs science subjects was also stated to be very valid by material experts with an average score of 85.7% 2) The development of multimedia SETS-based learning in class VII SMP / MTs science subjects was stated to be very practical by students with an average rating of 92.7%. Thus, SETS-based multimedia learning in class VII SMP / MTs science subjects is appropriate to use.

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