Development of multimedia learning based inquiry on vibration and wave material

H Madeali¹ and B K Prahani²

¹Department of Physics Education, Faculty of Teacher Training and Education
Haluoleo University, Indonesia
Jl. H.E.A. Mokodompit, Kendari, 93231, Indonesia

²Department of Physics, Faculty of Mathematics and Natural Sciences
Universitas Negeri Surabaya, Indonesia
Jl. Ketintang, Surabaya 60231, Indonesia

E-mail: binarprahani@gmail.com

Abstract. This study aims to develop multimedia learning based inquiry that is interesting, easy to understand by students and streamline the time of teachers in bringing the teaching materials as well as possible to be used in learning the physics subject matter of vibration and wave. This research is a Research and Development research with reference to ADDIE model that is Analysis, Design, Development, Implementation, and Evaluation. Multimedia based learning inquiry is packaged in hypertext form using Adobe Flash CS6 Software. The inquiry aspect is constructed by showing the animation of the concepts that the student wants to achieve and then followed by questions that will ask the students what is observable. Multimedia learning based inquiry is then validated by 2 learning experts, 3 material experts and 3 media experts and tested on 3 junior high school teachers and 23 students of state junior high school 5 of Kendari. The results of the study include: (1) Validation results by learning experts, material experts and media experts in valid categories; (2) The results of trials by teachers and students fall into the practical category. These results prove that the multimedia learning based inquiry on vibration and wave materials that have been developed feasible use in physics learning by students of junior high school class VIII.

1. Introduction

The rapid development of technology has a role that can be utilized for various purposes including for education and learning. This is indicated by the number of choices or ways that can be used in learning. One of them is the utilization of multimedia in learning [1-3]. The development of multimedia technology unlocks great potential in changing ways of learning and how to obtain information [4-6]. The development of multimedia has opened the opportunity for teachers to develop the learning system in order to get optimal results. Similarly for students, with multimedia learning will be easier to determine in what way and how to absorb the information delivered quickly and efficiently. The sources of information and knowledge that students acquire are no longer only fixated on books but more widely and diverse [4-7].

One of the classifications of multimedia learning is hypermedia [1]. Hypermedia is a medium that has the composition of materials that are not sequential. The term hypertext describes non-consecutive
documents, consisting of text, audio and visual information stored on a computer. Hypertext is viewed as nonlinearly organized information and accessed in textual form including diagrams, tables and drawings [2]. Unlike textbooks, hypertext can be presented by combining it with other media such as animation, sound, images, and graphics. Hypertext makes it easier for us to find the materials we want because the subject matter is neatly sorted by using the help of links [3]. Links have a sense of the relationship of each node or part that becomes the infrastructure of each node or part of it to connect to text, graphics, audio, video and other animations. Hypertext can be used as one of the tools that allow learners to build their own knowledge. But there are also deficiencies in the use of hypertext, hypertext systems can be made in various ways, but there is enough reason to believe that most of these ways will not produce good learning results. This is because the hypertext can just make the reader confused. Readers have gone astray in links with so many branches. In addition, since nothing will deter the reader from linking the two nodes of information and continuing with other vertices, there is the possibility that navigation will end up with some incoherent information. The creation of multimedia using hypertext needs to be neatly compiled, so it will not cause the multimedia users to get lost in the [1-10] information link.

This finding is of particular concern to the improvement of multimedia implementation in physics learning. Implementation of multimedia can be applied in physics learning [7-10]. One of them is by inquiry learning [11-16]. The study of inquiry has been shown to improve the skills of the process of science, conceptualization, creativity, learning outcomes, problem solving, critical thinking, and student creativity [17-30]. The inquiry model is defined as one of the inquiry learning model that presents the problem, the questions and the material or the supporting material is determined by the teacher. Teachers given problem encourage students to investigate and determine the answers [32-34]. The inquiry model offers an integrated investigation planned and guided by librarians and teachers, enabling students to gain a better understanding of the subject matter of curriculum content and concept information. Develop the skills and abilities necessary for work and everyday life in the 21st century [21,27,31]. The social constructivism theory developed by Vygotsky has three major implications in the impression of the inquiry model: 1) through the social interaction of the students become conscious of their basic mental function and able to use them for growth; (2) the teacher provides the tasks within the range of students (zone of proximal development); (3) Providing learning with scaffolding [35-36]. According to Lev Vygotsky, language and thought will become increasingly independent in the development of the child [37]. Vygotsky states that children develop a more systematic, rational concept that is the result of dialogue with a skilled counsellor [38-40]. Language and thought will become increasingly independent in the development of the child when the multi-representational ability of the student develops optimally [37].

Inquiry learning can encourage learning toward the student centred, where the teacher's position shifts from the traditional instructor to the mentor [17-30]. In addition, student-centered learning can lead to active, creative, interactive, and fun learning [32-34]. Multimedia utilization is expected to help students understand the material learned because by using multimedia students can obtain information that is difficult to be presented in the student's learning room even more so in the process of physics learning which most of the material is abstract [1-10]. Supported by the use of hypertext that is part of the multimedia element itself can make students more interested in learning because the use of hypertext is different from ordinary text books, hypertext can store text, animation in it that has been linked by the link that makes it more interesting [1-6] . In addition, the addition of aspects of inquiry makes students into learning centres that no longer make teachers as learning centres, so students are required to be able to find the concept of what he learned [1-6]. This makes the student more understand the material he learned because the concept of the material he found himself and make the science he studied longer stored in him. Researchers will have developed an inquiry-based hypertext multimedia to enhance the physics concept of vibration and wave matter. Stages of development research refer to the ADDIE development model by Dick and Carey, including Analysis, Design, Development, Implementation, and Evaluation [41]. The formulation of this research problem as follows.
a. How is the validity of multimedia learning based inquiry on vibration and wave materials developed?
b. How is the practicality of multimedia learning based inquiry on vibration and wave materials developed?

2. Methodology of Research

2.1. Time and Place of Study Implementation
The research was carried out in February 2016 to finish in Laboratory of Department of Physics Education Faculty of Teacher Training and Education University of Halu Oleo Kendari and tested in state junior high school of 5 Kendari.

2.2 Types of Research
This type of research is research development (Research & Development) to develop multimedia learning based inquiry on vibration and wave materials.

2.3 Research Design
This research uses Research and Development. The research stages are based on the ADDIE development model developed by Dick and Carey (1978), including Analysis, Design, Development, Implementation, and Evaluation.

2.4 Research Instruments
In the validation by experts consists of 3, which includes 2 learning experts, 3 material experts and 3 media experts While in the trial phase consists of 2 that includes teacher responses to the program and student responses to the program. The validation sheet given to the experts is to determine the level of validity and learning multimedia developed. While the questionnaire given to teachers and students aims to determine the practicality level of developed multimedia learning. The validation sheet is a questionnaire.

2.5 Data Analysis Techniques
Determination of the validity level and practicality of multimedia learning based inquiry on vibration and wave materials developed using assessment criteria by [42-44].

3. Result and Discussions of Research

3.1 Validity of Multimedia Learning Based Inquiry on Vibration and Waves Materials
Multimedia learning based inquiry on vibration and wave materials is packaged in hypertext form using Adobe Flash CS6 Software. The inquiry aspect is constructed by showing the animation of the concepts that the student wants to achieve and then followed by questions that will ask students what is observable from the animation. The validity of multimedia learning based inquiry on the vibration and wave materials that has been developed is then validated by 2 learning experts. The validation results are presented in Table 1. The validity of multimedia learning based inquiry on vibration and wave materials with an average of 86.10 with valid and reliable categories, so that it can be used in physics learning on vibration and wave materials.

Multimedia learning based inquiry on vibration and wave materials that has been developed is then validated by 3 content experts. The validation results are presented in Table 2. The validity of instructional media with the average percentage of 83.30 with valid and reliable categories, so that it can be used in physics learning on vibration and wave materials.
Table 1. Validity of multimedia learning based inquiry on vibration and wave materials by 2 learning experts.

| Validity of multimedia learning based inquiry on vibration and wave materials by 2 learning experts | Validity | Reliability |
|-------------------------------------------------------------------------------------------------|---------|-------------|
| 1. Interesting multimedia is used                                                                 | 100     | Valid       |
| 2. Ease of multimedia users                                                                      | 100     | Reliable    |
| 3. Material compatibility with student characteristics                                          | 75.00   | Valid       |
| 4. Clarity of feedback / response                                                                 | 75.00   | Reliable    |
| 5. Use of Hypertext words                                                                        | 62.50   | Valid       |
| 6. The inquiry is seen in the presentation of matter                                              | 100     | Reliable    |
| 7. The precision of the presentation sequence                                                     | 87.50   | Valid       |
| 8. Ease of understanding the content (content) of the lesson                                      | 87.50   | Valid       |
| 9. Ease of understanding of sentence there is text / writing                                     | 75.00   | Reliable    |
| 10. Clarity of learning instructions                                                              | 100     | Reliable    |
| 11. Material compatibility with learning objectives                                               | 87.50   | Valid       |
| 12. Adequacy of the given example                                                                 | 75.00   | Valid       |
| 13. Sufficiency of material description in clarity of concept of vibration and wave               | 75.00   | Valid       |
| 14. Clarity of target use of multimedia learning                                                 | 100     | Reliable    |
| 15. Conformity of material sequences contained in the media                                       | 75.00   | Valid       |
| 16. Conformity of the material with the basic competencies used                                   | 100     | Reliable    |
| 17. Conformity of the material with the basic competencies used                                   | 87.50   | Valid       |

Table 2. Validity of multimedia learning based inquiry on vibration and wave materials by 3 content experts.

| Validity of multimedia learning based inquiry on vibration and wave materials by 3 content experts | Validity | Reliability |
|-------------------------------------------------------------------------------------------------|---------|-------------|
| 1. Conformity test with answer key                                                               | 91.70   | Valid       |
| 2. Compliance test with basic competencies and indicators                                        | 75.00   | Valid       |
| 3. Response or answer key                                                                        | 91.70   | Valid       |
| 4. Exact precision                                                                               | 83.30   | Valid       |
| 5. Into the material suitability of the image                                                     | 83.30   | Valid       |
| 6. Use of hypertext words                                                                        | 83.30   | Valid       |
| 7. Use of language                                                                               | 91.70   | Valid       |
| 8. The inquiry aspect is seen in the presentation of the material                                 | 66.70   | Valid       |
| 9. The truth of material substance                                                               | 83.30   | Valid       |

Multimedia learning based inquiry on vibration and wave materials has been developed and then validated by 3 media experts. The validation results are presented in Table 3. The validity of instructional media with an average of 85.40 with valid and reliable categories, so that it can be used in physics learning on vibration and wave materials.
Table 3. Validity of multimedia learning based inquiry on vibration and wave materials by 3 media experts.

| Validity of multimedia learning based inquiry on vibration and wave materials by 3 media experts | Validity | Reliability |
|-------------------------------------------------------------------------------------------------|---------|-------------|
| 1. Efficiency of text                                                                          | 83.30   | Valid Reliable |
| 2. Efficiency of screen usage                                                                   | 83.30   | Valid Reliable |
| 3. Clarity of instructions for use                                                               | 83.30   | Valid Reliable |
| 4. Consistency of the button                                                                     | 91.70   | Valid Reliable |
| 5. Navigation                                                                                    | 91.70   | Valid Reliable |
| 6. Fascination and motivation                                                                    | 91.70   | Valid Reliable |
| 7. Quality of interaction                                                                       | 83.30   | Valid Reliable |
| 8. Ease of language understanding                                                                | 83.30   | Valid Reliable |
| 9. Quality of interaction                                                                       | 83.30   | Valid Reliable |
| 10. Ease of understanding language                                                               | 91.70   | Valid Reliable |
| 11. Quality of animation                                                                        | 83.30   | Valid Reliable |
| 12. Audio quality                                                                                | 83.30   | Valid Reliable |
| 13. Quality of photos, pictures, graphics                                                         | 83.30   | Valid Reliable |
| 14. Colour composition                                                                           | 91.70   | Valid Reliable |
| 15. Type and size of text                                                                        | 83.30   | Valid Reliable |
| 16. Use of hypertext words                                                                       | 91.70   | Valid Reliable |
| 17. Use of the button                                                                            | 83.30   | Valid Reliable |
| 18. Menu view                                                                                    | 75.00   | Valid Reliable |

The creating of multimedia learning based inquiry on vibration and wave materials has passed the development stage using the ADDIE model. After passing through these stages a multimedia learning is produced. Multimedia learning is then validated by 2 learning experts, 3 material experts, and 3 media experts. Table 1, Table 2, and Table 3 show the results of validation by 2 experts obtained the final value of 86.10, then the validation results by 3 material experts obtained the final value 83.30 and the results of validation by the media expert obtained the final value of 85.40. The final grades obtained from the learning expert, the material expert and the media expert enter the valid percentage range based on the qualification of the validity rate.

Based on the data in Table 1, Table 2, and Table 3 indicates that multimedia learning based inquiry on vibration and wave materials has been declared valid and reliable by learning experts, materials experts, and media experts. Multimedia learning based inquiry on vibration and wave materials can be used in physics learning. The results of this study in accordance with the findings of previous research that the implementation of multimedia can be applied in the learning of physics [7-10], Hypertext can be used as one of the tools that give opportunity to the learners to build their own knowledge [1-3]. The integration of the inquiry model also received a positive assessment from the validator. This is supported by research [17-30] that inquiry learning can encourage learning toward the student centred, where the teacher position shifts from traditional instructor to mentor [17-30]. The development of multimedia learning based inquiry on vibration and wave materials that has been valid and can be used in physics learning is supported by social constructivism theory Vygotsky namely: 1) through social interaction students become aware of their basic mental function and are able to use it for growth; (2) the teacher provides the tasks within the range of students (zone of proximal development); (3) Providing learning with scaffolding [35-36].

3.2 The practicality of multimedia learning based inquiry on vibration and wave materials

The limited trial stage was conducted by giving questionnaires to 3 teachers of Junior High School and 23 students of State Junior High School of 5 Kendari. Limited trials are conducted in order to know the practicality level of multimedia learning in helping the learning process of students. Table 4 shows
that the practicality of multimedia learning based inquiry on vibration and wave material by 3 teachers is 94.20 very good and reliable categories.

**Table 4.** Practicality of multimedia learning based inquiry on vibration and wave materials by 3 teachers.

| Practicality of multimedia learning based inquiry on vibration and wave materials by 3 teachers | Practicality | Reliability |
|---------------------------------------------------------------------------------------------|--------------|-------------|
| 1. Interesting multimedia is used                                                            | 100          | Very good   |
| 2. Ease of multimedia users                                                                  | 100          | Very good   |
| 3. Material compatibility with student characteristic                                        | 91.70        | Very good   |
| 4. Clarity of feedback / reason                                                              | 83.30        | Very good   |
| 5. Use of Hypertext words                                                                    | 91.70        | Very good   |
| 6. Adequacy of the given example                                                             | 91.70        | Very good   |
| 7. The precision of the presentation sequence                                                | 100          | Very good   |
| 8. Ease of use of the content (content) of the lesson                                        | 100          | Very good   |
| 9. Ease of understanding of sentences in the text                                             | 100          | Very good   |
| 10. Clarity of learning instructions                                                          | 91.70        | Very good   |
| 11. The inquiry aspect is seen in the presentation of the material                           | 100          | Very good   |
| 12. Conformity of material with purpose / indicator                                          | 91.70        | Very good   |
| 13. Achievement of basic indicators and competencies                                         | 83.30        | Very good   |

Table 5 shows that the practicality of multimedia learning based inquiry on vibration and wave materials by 23 students is 83.90 categories is very good and reliable.

**Table 5.** Practicality of multimedia learning based inquiry on vibration and wave materials by 23 students.

| Practicality of multimedia learning based inquiry on vibration and wave materials by 23 students | Practicality | Reliability |
|---------------------------------------------------------------------------------------------|--------------|-------------|
| 1. Adequacy questions                                                                        | 81.70        | Very good   |
| 2. Quality of interaction                                                                     | 81.70        | Very good   |
| 3. Ease of understanding language                                                             | 80.00        | Very good   |
| 4. Use of hypertext                                                                          | 80.90        | Very good   |
| 5. Use of images                                                                             | 80.90        | Very good   |
| 6. Matching of Colour                                                                        | 87.80        | Very good   |
| 7. Key Clarity                                                                              | 93.00        | Very good   |
| 8. Display                                                                                  | 93.00        | Very good   |

Multimedia learning based inquiry on vibration and wave materials that has been valid and reliable is used in the implementation of physics learning. Multimedia learning based inquiry on vibration and wave materials was tested to 3 junior high school teachers and 23 students of State Junior High School of 5 Kendari. The final score obtained from the teacher's test is 94.20 (very good and reliable) and the test by the students is 83.90 (very good and reliable). The findings of this study are supported by [17-30] that the study of mercury has been shown to improve the skills of the science process, conceptual satisfaction, creativity, learning outcomes, problem solving, critical thinking, and student creativity. Student-centred inquiry can lead to active, creative and interactive learning, and fun [32-34]. Multimedia utilization is expected to help students understand the material learned because by using multimedia students can obtain information that is difficult to be presented in the student's learning room even more so in the process of physics learning which most of the material is abstract [1-10]. Supported by the use of hypertext that is part of the multimedia element itself can make
students more interested in learning because the use of hypertext is different from ordinary text books, hypertext can store text, animation in it that has been linked by the link that makes it more interesting [1-6]. In addition, the addition of aspects of inquiry makes students into learning centres that no longer make teachers as learning centres, so students are required to be able to find the concept of what he learned [1-6]. The results of this study indicated that multimedia based learning inquiry on vibration and wave materials was feasible use in physics learning at junior high school level because it has been declared valid and practical.

4. Conclusion
Multimedia based learning inquiry is packaged in hypertext form using Adobe Flash CS6 Software. The inquiry aspect is constructed by showing the animation of the concepts that the student wants to achieve and then followed by questions that will ask the students what is observable. Multimedia learning based inquiry is then validated by 2 learning experts, 3 material experts and 3 media experts and tested on 3 junior high school teachers and 23 students of state junior high school 5 of Kendari. The results of the study include: (1) Validation results by learning experts, material experts and media experts in valid categories; (2) The results of trials by teachers and students fall into the practical category. These results prove that the multimedia learning based inquiry on vibration and waves materials that have been developed feasible use in physics learning by students of junior high school class VIII.

5. Acknowledgements
The author’s gratitude goes to the Ministry of Research, Technology and Higher Education who has funded the Research. Likewise, the author's gratitude goes to the Haluleo University and SMPN 5 Kendari that has provided research opportunities.

References
[1] Ismiasri T 2011 Cakrawala Pend. 13 5
[2] Aliwar 2013 Al-Izzah 8 2
[3] Putra I B G A 2013 Kumpulan Artikel Mahasiswa Pend. Teknik Informatika 2 5
[4] Mayer R E 2001 Multimedia Learning (New York: Cambridge University Press)
[5] Mayer R E 2003 Learn. Instr. 13 125
[6] Mayer R E 2005 The Cambridge Handbook of Multimedia Learning (Cambridge: Cambridge University Press)
[7] Schnottz W and Lowe R 2010 Learn. Instr. 13 117
[8] Schnottz W and Lowe R 2003 Learn. Instr. 13 116
[9] Kustijono R J. Penelit. Fis. Apl. 2 10
[10] Habibullh M, Jatmiko B and Widodo W 2017 J. Penelit. Fis. Apl. 7 27
[11] Ariesta R and Supartono 2011 J. Pend. Fis. Indonesia 1 62
[12] Ashiq H A, Muhammad A and Azra S 2011 Int. J. Humanities Soc. Sci. 1 269
[13] Astuti Y and Setiawan B 2013 J. Pend. IPA Indonesia 2 88
[14] Ferlina I, Suyatna and Maharta J. Pend. Fis. 1 175
[15] Wenning C J 2011 J. Phys. Teach. Educ. Online 6 7
[16] Prahan B K, Limatuh A, Soegimin W W, Yunita L and Nur M 2016 Int. J. Educ. Res. 4 231
[17] Ambarsari W, Santosa S and Maridi 2012 J. Pend. Biologi Universitas Sebelas Maret 5 81
[18] Berg C A R, Bergendahl V C B and Lundberg B K S 2003 Int. J. Sci. Educ. 25 112
[19] Crawford B A 2000 J. Res. Sci. Teach. 37 916
[20] Crockett M D 2002 Teach. Teach. Educ. 18 609
[21] Gerald F L 2011 Scan. 30 26
[22] Khan M S, Hussain A R, Majoka M I and Ramzan M 2011 Int. J. Acad. Res. 3 955
[23] Kirschner P A, Sweller J and Clark R E 2006 Educ. Psychol. 41 75
[24] Lee H, Linn M, Varma K and Liu O 2010 J. Res. Sci. Teach. 47 71
[25] Luft J 2001 *Int. J. Sci. Educ.* **23** 517
[26] Michal Z 2007 *Res. Sci. Educ.* **3** 59
[27] Opara J A and Oguzor N S 2011 *Current Res. J. Soc. Sci.* **3** 188
[28] Pandey G K Nanda and Ranjan V 2011 *J. Innovative Res. Educ.* **1** 7
[29] Sadeh I and Zion M 2009 *J. Res. Sci. Teach.* **46** 1137
[30] Wilson C D, Taylor J A, Kowalski S M and Carlson J 2010 *J. Res. Sci. Teach.* **47** 276
[31] Benckert and Pettersson 2008 *Eur. J. Math. Sci. Techno. Educ.* **2** 121
[32] Abdurrahman, Liliasari, Rusli A and Bruce W 2011 *Cakrawala Pendidikan* **30** 30
[33] Bao L, Fang K, Cai T, Wang J, Yang L, Cui L, Han J, Ding L and Luo Y 2009 *Am. J. Phys.* **77** 1118
[34] Mercer N, Dawes L, Wegerif R and Sams C 2004 *British Educ. I Res. J.* **30** 359
[35] Arends R I 2012 *Learning to Teach* (New York: McGraw-Hill Companies)
[36] Slavin E R 2011 *Educational Psychology Theory and Practice* (USA: Pearson)
[37] Moreno R 2010 *Educational Psychology* (New York: John Wiley & Sons Inc)
[38] Fu Y, Han C T and Hui L W 2013 *Australasian J. of Educ. Techno.* **29** 89
[39] Zydney J M 2010 *Computers and Education* **54** 150
[40] Yu F Y 2009 *Computers in Human Behavior* **25** 1129
[41] Walter D and Carey L 1978 *The Systematic Design of Instruction* (USA: Scott, Foresman and Company)
[42] Arikunto S 2010 *Prosedur Penelitian Suatu Pendekatan Praktik* (Yogyakarta: Rineka Cipta)
[43] Fraenkel J R, Wallen N E and Hyun H H 2012 *How to Design and Evaluate Research in Education* (New York: McGraw-Hill)
[44] Plomp T and Nieveen N 2013 *Educational Design Research* (Enschede: SLO)