Development and Testing of Biology Learning Multimedia Effectiveness

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Abstract. This study aims to develop interactive multimedia learning based on Adobe Flash with the nervous system material to determine the level of product feasibility and the effectiveness of learning outcomes of students of class XI MAN 1 Maluku Tengah. This research method is Research and Development refering to the steps of the ADDIE development model. The product in the form of files in the .exe format, so the product can be directly used on many types of computers without the need to install the Adobe Flash CS6 program. Product testing consists of an alpha test and a beta test to determine the level of product feasibility and test the effectiveness of products on student learning outcomes. Data collection techniques used means of interviews, questionnaires, and tests. The data that have been collected were analyzed by qualitative descriptive technique. The results showed that the products developed were suitable for learning based on alpha testing and beta testing with very good and effective results to improve student learning outcomes with moderate criteria.

Keywords: Development; Effectiveness; Interactive multimedia; Biology; Nervous system.

1. Introduction

Teaching and Learning process will be carried out well if all factors in the learning process can run well. One of factors is learning media. If the learning media is chosen correctly, the learning place can take optimally. Coordination system, especially in sub-matter of the nervous system which is one of the biological materials being taught in grade XI of Senior High School [1]. The nervous system in humans is a system that incorporated regards the regulatory system in the human body as the center of balance [1]. So that this subject or teaching materials can be studied and understood correctly, the learning component is the key. Learning component includes how the competencies of teachers in teaching, completeness of the materials, used of materials and the media that is used by teachers, Its mind how the learning media can facilitate the learning process so that competence can be achieved. The used of appropriate learning media can have an effect on the achievement of learning goals and can create conducive and interactive learning activities as soon as students actively in learning activities [2]. According to [3], the used of appropriate media and varied learning media can resolve of
passive students. In this case, the instructional media used to attract attention, so bring the joy of learning, allowing interaction between peer of students and the environment of learning in accordance with their interests and student ability.

Learning media is all of tools that can be used to delivered information from the sender to the receiver [4]. One type of media that can be used is interactive multimedia. In the learning process with interactive multimedia, teachers can utilize visual expression and verbal to increase student understanding [5]. Used of multimedia learning can be solutions to assist in overcoming the problem of learning, increase student interactivity is not maximized, as well as improving of student learning outcomes. However, this is not supported by the facts in school, especially in MAN 1 Maluku Tengah, there are a some of instructional media with less condition or non-optimal as a bad quality. There are media that are not easily accessible is causing teachers and students are not interested in the available media. This is evidenced by the attitude of teachers and students lack the spirit of the learning process when using existing learning media. Especially on the subjects of biology teachers due to limited knowledge about interactive multimedia.

Interactive multimedia can facilitate teachers and students in the learning process. This learning media created with the help of software, the presentation of the contents of the material made it interesting with the addition of a combination of words (such as text spoken or written text) and images (such as illustrations, photographs, animations and videos) [6], [7], [8], which is integrated into the form of information or program instructions [9] contained in the material it can be delivered to students in a more effective, efficient, wider, faster, more interesting and meaningful for the study, especially for the students [10] [11]. Today the development of software is so quickly. One of them is Adobe Flash. Adobe Flash is a program devoted to the designers and programmers who intend to design animations, presentations, and learning to the creation of interactive games as well as other goals that are more specific [12] and the application can also be used for loading logos, films, makes navigating web sites, banners, animated buttons, menus, interactive form fields, e-cards, server screen, and creating web sites or other web production application [13].

Manufactured and used of multimedia in the learning process is not only limited to the conditions and needs of students, but also must pay attention to aspects of management of learning materials that will be presented in the media. Therefore, this study aims to develop interactive multimedia based on Adobe Flash CS6 for students of Grade XI in MAN 1 Maluku Tengah Senior High School and to knowing the effectiveness of interactive multimedia.

The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3 presents the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Proposed Research Method

This research was the Research and Development (R & D), which was used to produce a specific product and test the effectiveness of these products [14], [15] which refers to measures development model ADDIE (Analysis, Design, Development, Implementation, and Evaluation) [16], [17], [10] as can be seen in Figure 1. Product testing consist of alpha test (2 media expert and two expert material) and the beta test to determine the feasibility of the product (1 biology teacher and five students of Eleventh grade in MAN 1 Maluku Tengah) and test the effectiveness of the product against the achievements of the learning outcomes of students (20 students of Eleventh Grade in MAN 1 Maluku Tengah chosen randomly). The data collection techniques was by interviews, questionnaires and tests. The collected data will be analyzed with descriptive qualitative.

3. Result and Discussion

The product was based on biology interactive learning multimedia adobe flash sub-material of nervous system as well as knowing the level of product feasibility and effectiveness of student learning
outcomes in class XI MAN 1 Maluku Tengah. Multimedia development method in this research used the ADDIE development model step. The stages of development models adapted from the model ADDIE consists of several steps, among others: (1) analysis, which stages a field survey covering the curriculum analysis, analysis of potential learners, biology teacher potential analysis and needs analysis; (2) design, the planning and structural framework of multimedia in biological learning program based of adobe flash; (3) development, while the stages are multimedia production, alpha test, and beta test; (4) implementation, which stages the use of multimedia-based learning biology adobe flash, there are two times of testing is limited trials and field trials; (5) evaluation, the steps being taken to find out the deficiencies and effectiveness of products developed in the use of large scale or in field testing (see Appendix).

At this stage, researchers will describe the results of data processing that has been obtained. The data presented in the form of test data Alpha (alpha testing), test data Beta (beta testing), and the effectiveness of the test data. Here is an explanation of each data.

### Figure 1. Development Learning Device ADDIE Models

3.1 Alpha Test Data (Alpha Testing)

Results validation from the media consisted of two respondents is Lecturer Learning Technology Graduate University of Yogyakarta who are experts in the development of instructional media. The first media Validator is Dr. Ali Muhtadi and the second media validator is Prof. Dwi Herman Surjono. In this assessment there are four aspects that is auxiliary Information Aspect, Interface, Navigation and robustness [18]. The results of the validation of media experts, are presented in the following Table 1:

| Validator | Statement | 1 | 2 | Average |
|-----------|-----------|---|---|---------|
|            | auxiliary Information |     |   |         |

Table 1. Results of Media Expert Assessment
Based on Table 1 above, it is noted that the first Media Experts assess this learning multimedia with an average score of 3.75 on a scale of 4 criteria “Very Decent”. The second media experts assess this learning multimedia with an average score of 3.69 on a scale of 4 to criteria “It's Worth”. Then the overall average score for the assessment in terms of the media are in a score of 3.72 with the criteria of "It's Worth". The assessments by the learning multimedia media experts are presented in the Figure 2.

**Table 1**

|   | Clarity on the program title of the home screen | 4 | 3 | 3.5 | very Decent |
|---|------------------------------------------------|---|---|-----|-------------|
| 2 | The attractiveness of the home screen / opener | 4 | 4 | 4   | very Decent |
| 3 | Availability of the instructions for use       | 4 | 4 | 4   | very Decent |
| 4 | The accuracy of the selection of font size     | 3 | 4 | 3.5 | very Decent |
| 5 | The accuracy of the selection typeface         | 4 | 4 | 4   | very Decent |
| 6 | Consistency menu display                       | 4 | 4 | 4   | very Decent |
| 7 | The accuracy of the placement of text          | 4 | 3 | 3.5 | very Decent |
| 8 | The precision placement of images / animations| 4 | 3 | 3.5 | very Decent |
| 9 | The accuracy of the video placements           | 4 | 4 | 4   | very Decent |
| 10| Quality music / sound                          | 4 | 3 | 3.5 | very Decent |
| 11| The composition of colors                      | 3 | 4 | 3.5 | worthy     |
| 12| The accuracy of the selection of text and background color (background) | 3 | 3 | 3 | worthy |

**Navigation**

|   | Ease of understanding the navigation buttons | 4 | 4 | 4 | very Decent |
|---|---------------------------------------------|---|---|---|-------------|
| 14| The consistency of the navigation keys      | 4 | 4 | 4 | very Decent |
| 15| Conformity and reaction speed with the      | 3 | 4 | 3.5 | worthy     |

**Robustness**

|   | Operating system performance program        | 4 | 4 | 4 | very Decent |
|---|---------------------------------------------|---|---|---|-------------|
|    | Amount                                      | 60| 59| 59.5| very Decent |
| Average |                                      | 3.75| 3.69| 3.72| very Decent |

**Figure 2.** Results of Media Expert Assessment
In a Qualitative, the above results demonstrate this learning multimedia in terms of media included in the category of "Very Decent" ($\geq 3.25$). Both experts concluded that learning multimedia is ready to be tested at a later stage with some suggestions and improvements. Validation results in terms of material consisting of two respondents who are experts in the field of biology. The first validator such as Prof. Djukri, he is a lecturer in Biology Education Study Program, School of Graduate Studies, UNY and second validator is Drs. He Aliru, biology teacher of MAN 1 Maluku Tengah. In this assessment there are three aspects, namely the assessment aspect of Subject matters, Pedagogy and Affective considerations [18]. The results of the validation by subject matter experts, are presented in the Table 2:

Table 2. Results of Validation Expert Content

| Validation | Statement                                                                 | 1  | 2  | Average | Criteria         |
|------------|---------------------------------------------------------------------------|----|----|---------|------------------|
| **Subject matters** |                                                                           |    |    |         |                  |
| 1          | The suitability of the learning objectives and content                      | 4  | 4  | 4       | very decent      |
| 2          | depth Content                                                              | 3  | 3  | 3       | worthy           |
| 3          | The truth of the matter                                                    | 3  | 3  | 3       | worthy           |
| 4          | Material Actualization (up to date)                                        | 4  | 4  | 4       | very decent      |
| 5          | Sequences of material                                                      | 3  | 3  | 3       | worthy           |
| 6          | The clarity of the language used / Communicative                           | 3  | 4  | 3.5     | very decent      |
| 7          | The suitability of the use of language with the target level               | 3  | 3  | 3       | worthy           |
| 8          | Availability overview                                                      | 3  | 3  | 3       | worthy           |
| 9          | Suitability of learning objectives and evaluation                          | 4  | 4  | 4       | very decent      |
| 10         | Clarity manuals of evaluation                                              | 3  | 4  | 3.5     | very decent      |
| 11         | Evaluation covers material taught                                          | 4  | 4  | 4       | very decent      |
| **Pedagogy** |                                                                           |    |    |         |                  |
| 12         | Careful selection of media elements in presenting the material             | 3  | 4  | 3.5     | very decent      |
| 13         | Conformity with the material image                                         | 4  | 4  | 4       | very decent      |
| 14         | Compliance is animated by material                                         | 4  | 4  | 4       | very decent      |
| 15         | Conformity video material                                                  | 4  | 4  | 4       | very decent      |
| 16         | The effectiveness of the presentation of the material in terms of time     | 3  | 3  | 3       | worthy           |
| **Affective considerations** |                                                               |    |    |         |                  |
| 17         | Grain material in motivating learning                                      | 4  | 4  | 4       | very decent      |
| Amount     |                                                                           | 59 | 62 | 60.5    | very decent      |
| Average    |                                                                           | 3.47 | 3.65 | 3.56    |                  |
Based on Table 2 above, it is noted that the first material experts assess this learning multimedia with an average score of 3.47 on a scale of 4 criteria "Very Decent". The second material experts assess this learning multimedia with an average score of 3.65 on a scale of 4 to criteria "It's Worth". With the results of the second expert assessment of these materials, the average obtained is at a score of 3.56 with the criteria of "It's Worth". The following assessment by experts of multimedia learning material presented in Figure 3.

![Assessment of Expert Content Score](image)

**Figure 3. Assessment Expert Content**

In a Qualitative, the above results demonstrate this learning multimedia in terms of material included in the category of "Very Decent" ($x > 3.25$). Both experts concluded that learning multimedia is ready to be tested at a later stage with some suggestions and improvements.

### 3.2 Beta Test Data (Beta Testing)

Beta Test Phase (Beta Testing) involves six respondents consisting of one teacher of Biology and 5th grade students of MAN 1 Maluku Tengah. These five students were selected randomly from a total number of 120 students of class MAN 1 Maluku Tengah. Assessment in this beta test using questionnaire instrument multimedia feasibility study in terms of user response has also been advance validated by expert instrument. The results of the assessment phase Beta Test (Beta Testing), are presented in the following Table 3.

| Table 3. User Rating |
|----------------------|
| Statement | Score | Average | Criteria |
|-----------|-------|---------|----------|
| Media Aspect | G1 | S1 | S2 | S3 | S4 | S5 | |
| 1 Readability | 4 | 4 | 4 | 4 | 4 | 4 | 4 | Very Decent |
| 2 Picture Clarity/ animation | 3 | 4 | 4 | 4 | 4 | 4 | 3.8 | Very Decent |
| 3 Video Clarity | 4 | 4 | 3 | 4 | 4 | 4 | 3.8 | Very Decent |
| 4 Music Clarity/ Sound | 4 | 4 | 4 | 4 | 4 | 4 | 4 | Very Decent |
| 5 Color Suitability | 4 | 4 | 4 | 4 | 4 | 4 | 4 | Very Decent |
| 6 Attractive Appearance | 4 | 3 | 4 | 4 | 3 | 4 | 3.7 | Very Decent |
Based on Table 3 above, it is explained that Biology subject teachers provide an assessment with an average score of 3.64 on a rating scale 4 with the criteria of "Very Decent". Student 1 gives an assessment with an average score of 3.93 on a scale of 4 with the criteria of "Very Decent". Student 2 gives an assessment with an average score of 3.71 on a scale of 4 with the criteria of "Very Decent". Student 3 gives an assessment with an average score of 3.79 on a scale of 4 with the criteria of "Very Decent". Student 4 gives an assessment with an average score of 3.86 on a scale of 4 with the criteria of "Very Decent" and student 5 gives an assessment with an average score of 3.93 on a scale of 4 with the criteria of "Very Decent". With the results of the assessment of the six respondents, the overall average obtained was at a score of 3.8 with the criteria of "Very Decent". The following are the results of the assessment of the users presented in Figure 4.

**Figure 4. Results of User Assessment**
In a Qualitative, the results above show that this multimedia learning by user response is included in the "Very Eligible" category ($x > 3.25$). In addition, there is no suggestion and improvement on this multimedia, but some comments given by the respondents.

### 3.3 Effectiveness Test Data

The effectiveness test is a stage to find out the effectiveness of multimedia learning that was developed when applied to the teaching and learning process in the classroom. As a learning multimedia for students of class XI MAN 1 Maluku Tengah, the subject of the effectiveness test is class XI MAN 1 Maluku Tengah, totally have 20 students randomly selected.

The effectiveness test phase uses one group Pre-test and Post-test design [19] which lasts for 2 times face to face lessons. The first meeting began with the initial test (pre-test). This initial test aims to determine the level of students' initial understanding of the "nervous system" material. After that, the teaching and learning process continued as usual by using multimedia learning that was developed as a learning medium. This process lasts until the last meeting which is followed by the final test (post-test). The final test aims to determine the level of students' understanding of the material that has been taught with the help of developed learning multimedia.

#### Table 4. Results of the Initial Pre-Test and Post-Test

| Numb. Resp | Pre-Test Score | Post-Test Score | Numb. Resp | Pre-Test Score | Post-Test Score |
|------------|----------------|-----------------|------------|----------------|-----------------|
| 1          | 50             | 85              | 12         | 50             | 80              |
| 2          | 60             | 75              | 13         | 65             | 75              |
| 3          | 55             | 85              | 14         | 65             | 75              |
| 4          | 65             | 80              | 15         | 65             | 70              |
| 5          | 70             | 80              | 16         | 70             | 90              |
| 6          | 65             | 90              | 17         | 60             | 80              |
| 7          | 85             | 85              | 18         | 60             | 85              |
| 8          | 70             | 85              | 19         | 50             | 75              |
| 9          | 60             | 90              | 20         | 70             | 90              |
| 10         | 45             | 85              |            |                |                 |
| 11         | 60             | 90              |            |                |                 |

Average: 62 82.5

Based on the data in Table 4 above, it is explained that the mean of the initial test results (pre-test) was at a score of 62 with the lowest score obtained by students, namely 45, and the highest was 70. At the end of the test results (post-test) obtained a mean score of 82.5 with the lowest result obtained by students is 75, and the highest is 90. The following is the comparison of the scores of the initial test results and the final test presented in the Figure 5.
By referring to the data presented earlier, the calculation of the increase in scores using the N-Gain formula [20] is as follows.

\[ g = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \]

\[ g = \frac{82.5 - 62.0}{100.0 - 62.0} \]

\[ g = \frac{20.5}{38.0} \]

\[ g = 0.539 \]

Based on the above calculation, the gain value is 0.539 which is included in the "Medium" classification (0.70 > g > 0.3). The results of these calculations are presented in the following Table 5.

| No | Variable          | Pre-Test | Post-Test |
|----|-------------------|----------|-----------|
| 1  | Minimum Score     | 45       | 75        |
| 2  | Maximum Score     | 70       | 90        |
| 3  | Average           | 62       | 82.5      |
|    | Gain Score        |          | 0.539     |
|    | Gain Criteria     |          | Medium    |

Based on all the data in Table 5 above, it can be seen that there is an increase in scores between learning before using multimedia with after using multimedia seen from the initial test scores and final tests. Thus it can be concluded that the Adobe-based Multimedia Biology Learning Flash sub-material of the Nervous System for class XI MAN 1 Maluku Tengah Students proved effective with the level of "Medium"
effectiveness criteria. This is in line with the results of research [21] that multimedia is an effective medium to strengthen learning, student understanding and [22], [23] student learning outcomes. With innovative multimedia has great potential to enhance traditional learning [22].

4. Conclusion

Conclusions on the results of research on the development of adobe-based biology learning multimedia in the nervous system sub-material for the class XI MAN students are as follows: (1) Multimedia learning is developed through ADDIE (Analysis-Design-Develop-Implement-Evaluate) instructional design model; (2) Multimedia learning is in .exe format which is packaged in compact disc (CD); (3) Multimedia learning is considered "Very Decent" for students of class XI MAN 1 Maluku Tengah after passing the alpha test and beta test; (4) The effectiveness test results for learning multimedia proved effective by producing a mean score of 62 for the initial test (pre-test) and 82.5 for the final test (post-test), so that the N-gain score obtained was 0.539 with the criteria "Medium".

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Appendix: Biology Multimedia Instructional

Splash Screen

Cover

Home Screen

Page material menu

Illustration material

Material

Quiz

Developer Profile