Developing Multimedia-assisted Inquiry Learning Instruments for Basic Biology Intended to Foster Students’ Scientific Inquiry

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Abstract. Seasonal Influenza is one of disease that outbreaks periodically at least once every year. This disease caused many people hospitalized. Many hospitalized people as employers would infect production quantities, distribution time, and some economic aspects. It will infect economic growth. Infected people need treatments to reduce infection period and cure the infection. In this paper, we discussed a mathematical model of seasonal influenza with treatment. Factually, the disease was held in short period, less than one year. Hence, we can assume that the population is constant at the disease outbreak time. In this paper, we analyzed the existence of the equilibrium points of the model and their stability. We also give some simulation to give a geometric image about the results of the analysis process.

1. Introduction

In 2009 avian influenza was become epidemic and followed by swine flu epidemic [1]. Those epidemics made some death cases and many people hospitalization. The strain of H5N1 virus was identified as a cause of avian influenza epidemic, and Strain of H1N1 virus was identified as a cause of swine influenza while the cause of seasonal influenza is H3N2 virus. The symptoms of all influenza disease are similar. Influenza viruses were responsible for many death cases and many people hospitalization. Seasonal influenza usually does not cause death, and it has some effects economically i.e. productivity of employee will decrease, some production process needs longer time, some distribution of goods was suspended [2].

Factually, the infected persons need some treatments to cure infection like drugs assimilation and hospitalization. In [3], it was stated extending oseltamivir to infected children (1 – 3 years old) which don't exceed 24 hours after the symptoms give the significant result. Oseltamivir is known as the only one exact drug for the children under 15 years old. Committee on Infectious Diseases ([4]) also stated treatment should be offered as early as possible. In [5], it was stated that early treatment with antiviral medications may reduce the severity and duration of symptoms, hospitalizations, and complications (otitis media, bronchitis, pneumonia), and may reduce the use of outpatient services and antibiotics, extent, and quantity of viral shedding, and possibly mortality in certain populations. In [6], it was stated that giving the drug in earlier time will be reduced the infection period. In [6], it was also stated diagnosis and treatment would be faster the result of oseltamivir therapy. Urashima [7] suggested that one of the actions to reduce the incidence of influenza A, especially in specific subgroups of schoolchildren was vitamin D3 supplementation. In [8], it was stated that using oseltamivir prophylaxis can shorten the duration of influenza outbreaks. In [9,10], there were mutated viruses that have immunities of oseltamivir.
2. Methods
This study employed Research & Development (R&D). The R&D stages undertaken in this study included: (1) preparation; (2) development; and (3) field test [9]. In this research validity test was conducted through analysis of validation evaluation conducted by the expert validator. Meanwhile, a classroom test was conducted to measure the validity, reliability, difficulty level, and discriminating power of items intended to measure scientific work skills. Practicality was measured through evaluation of observation sheets over lecturer activities, and effectiveness was measured through observation sheets of students' scientific inquiry.

2.1 The Subjects
The subjects of this study were 27 preservice teachers at Science department in Nusantara Islamic University, Bandung, Indonesia. An expert validation test was conducted by two experts who held a doctoral degree and Associate professor level.

2.2 Data Analysis
An expert validation sheet consists of five choices of answers as follows: 1, 2, 3, 4, and 5. It refers to guidelines Liker's scale [9]. 1 = very poor, 2=poor, 3=fair, 4= good and 5= very good. The validation sheets were used to evaluate the relevance of depth, completeness, details, and readability of the materials being developed. The expert validation questionnaires consist of 54 items. The data was then analyzed and calculated a percentage of the total score. Practicality and effectiveness of the learning activities were analyzed based on observation sheets on students and lecturer activities. Meanwhile, the effectiveness criterion for the learning process was using Normal Curve Distribution [10,11,15], where highly effective learning process is between 85%-100%, effective learning process is valued between 70%-84%, fairly effective is between 55%-69%, less effective is between 50%-54% and not effective is between 0%-49%.

3. Results and Discussion
3.1 Description of Learning Instruments Development
This study has been through several steps from planning to development. On the development stage, validation and revision I was conducted at one class. The expert validator did an evaluation on the reliability and validity of the learning instruments and materials. The validation process covers all of the instruments and materials such as syllabus, lesson plan, learning materials, scientific inquiry tests, students’ worksheets, evaluation rubric, observation sheets, observation sheets on attitude, multimedia materials, and students’ responses observation sheets. The study developed materials and instruments for three chapters: two chapters about the environment and one chapter about reproduction. The multimedia materials were developed about students' need for tools to collect data and information for the inquiry learning. The scientific work indicators that are developed include data collection, hypothesis formulation, problem formulation, variable definition, prediction, counting, graphics, communication, and make conclusions [2].

Multimedia assisted inquiry learning, to begin with, students asking a question in their worksheets. Students were then given opportunities to read the problem presented in the worksheets to help them more focus on the given problem. Lecturers play the multimedia materials while students pay attention closely to it and take some notes. Discussion and information exchange activities are critical in students' scientific works. Students discuss the problems and make some scientific inquiry using the worksheets while lecturer acts as a facilitator who helps students understand the topic at hand.

3.2 Analysis of Validity Test Results on Learning Materials conducted by Expert Validator
The analysis of validity test results on learning materials conducted by expert validators is shown in the following Table 1:

| TABLE 1. Recapitulation of Expert Validator Analysis on Learning Materials |
Table 1 exhibits that all learning instruments are valid with the scores in 79.8%. Therefore, the instruments are deemed to be valid but need minor revisions. The revision was conducted based on notes and suggestions from both expert validators. These are 1) to pay attention more on the appropriateness of competencies sought by the course and the content in syllabus; 2) to manage the gradual improvement of the difficulties from easy to hard; 3) to not be concerned with the conceptual questions due to it being created by human being; 4) to include objectives and competence that will be pursued in the learning materials; 5) to revise items that have low validity; 6) to minimize the observation on students’ attitude in order to make the observation more focused; and, 7) to provide a high degree of thoroughness in the evaluation of a rubric.

3.3 Analysis of Validity and Reliability Test Results on Scientific Work Skill

The analysis of validity test results on scientific work skills is shown in Table 2 below.

| Types of Materials/Learning Instruments | Scores Validator I | Scores Validator II | Average Scores | % | Description |
|----------------------------------------|--------------------|---------------------|----------------|---|-------------|
| Syllabus (7 item)                      | 30                 | 26                  | 28             | 80| Valid       |
| Lesson Plan (6 item)                   | 25                 | 27                  | 26             | 86.7| Valid     |
| Learning Material Module (7 item)      | 27                 | 28                  | 27.5           | 78.6| Valid       |
| Scientific inquiry Test (6 item)       | 22                 | 24                  | 23             | 76.7| Valid       |
| Student Worksheets (4 item)            | 16                 | 16                  | 16             | 80| Valid       |
| Evaluation Rubrics (5 item)            | 18                 | 20                  | 19             | 76| Valid       |
| Observation Rubrics (5 item)           | 21                 | 22                  | 21.5           | 86| Valid       |
| Students’ Attitude Observation Sheets (4 item) | 15           | 16                  | 15.5           | 77.5| Valid       |
| Multimedia Learning (6 item)           | 24                 | 23                  | 23.5           | 78.3| Valid       |
| Students’ Responses Sheets (4 item)    | 15                 | 16                  | 15.5           | 77.5| Valid       |
| Average                                |                    |                    | 79.8           |   | Valid       |

Analysis of validity test results as shown above in Table 2 indicates that the 43 items of the test have been classified as valid with high-reliability level (0.96) and high correlation scores (0.78). Therefore, the items are deemed to be reliable and valid to use as instruments for data collection. However, there were 4 items that have low validity (<0.25) with low discriminating power, and high difficulty level. Therefore, the 4 test items were then recommended to be revised. The revision was conduct because there was a lack of necessary information to relate two variables being asked. Poor learners were not able to retrieve necessary information to compare both variables. Thus, by revising the chart into a clearer table, the information can be more retrievable by the students. It is in line with Zimmaro’s suggestion that students need to be equipped with a good knowledge about what being questioned [12]. Success at increasing students’ ability to ask questions is made more difficult if students do not already possess personal experience or prior knowledge of the topic to be studied. For these students, the purpose of inquiring may simply be to gather more information [13].

3.4 The Analysis of Lecturer and Students’ Activities
In Picture 1, the average scores of lecturer's activities in Material I was higher than the students. In Material I, the lecturer acted as a facilitator that explain and provide examples of scientific inquiry the students need to do. In the early stage, since the students had to make themselves adapt to scientific inquiry, they made several errors in working on worksheets. They made errors most frequently in the formulizing problem, developing a hypothesis, defining variables, developing graphics, and making conclusions. In following sessions, the lecturer has become less active while the students were more engaged in classroom inquiry activities. In Material II session, the students have developed understanding about the learning process through scientific activities. It indicated that the lecturer has successfully solved the problems in the class session where the students now have become highly motivated to conduct inquiry Lecturer acted as a facilitator has a positive impact on science teacher skills to organize student scientific inquiry. In other words, the learning session has become practically implemented with the practicality level in 81.8%. The effectiveness of learning session can be seen from the observation results where they can work on the worksheet effectively. The observation on the students' worksheet found that the learning activities have 72.73% level of effectiveness. Based on the analysis, there are 3 (three) inhibiting factors: 1) time management has become critical issue in developing and implementing the materials; 2) lecturer needs to motivate students to learn harder to avoid time extension; and, 3) learning activities highly depend on audio equipment, LCD, and computer.

4. Conclusion

This study concludes that there are some improvements made in the development of learning materials, including syllabus, teaching materials of scientific based basic biology, lesson plan, multimedia learning, students' worksheet, evaluation rubrics, scientific work test, observation sheets over students and lecturer's activities, and evaluation sheets on students' attitude, and students' responses sheets. The materials covered three chapters about awareness of environmental issues and one chapter about reproductions. The multimedia teaching aids were developed about students' needs to search for information and data for their inquiry. The indicators of scientific work this study developed to include the ability to collect data, formulize problem, formulize hypothesis, define variables, make predictions, counting, develop graphics, communicate findings, and draw conclusions. Validation test indicates that the learning materials are valid, reliable, practical, and effective. The study also found that time management, audio equipment, and computer were some of the factors that inhibit the process of the material development.

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