Developing e-learning media on education statistics subject

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Abstract. Lecturers as teachers must be able to create engaging, innovative learning based on ICT. Through this basis, it is necessary to develop e-learning learning media. Based on pre-observation at UT students on the Education Statistics subject, it is concluded that 1). Student’s learning outcomes were lacking, 2). many students could only absorb theory but could not apply it to daily problems. One of the solutions to overcome these problems is by developing e-learning media. Through the advantages of e-learning, e-learning learning media will be developed in the Education Statistics subject. This research aims to produce valid e-learning media. The subjects of this study were students of UT Semarang Pokjar Kendal district. The development of instructional media designs used the 4-D model from Thiagarajan, Semmel, and Semmel. Methods of data collection using questionnaires, interviews, and observations. The results showed that design of e-learning learning media was designed according to the characteristics of UT students. The validation results of 3 validators with an average of 4.1 with very valid category. The results of the legibility test were carried out twice with an average result of 87% which was included in the very good category.

1. Introduction
Technological advances in industrial revolution 4.0 must be able to be utilized by UT lecturers and students. The technology application in learning is imperative and necessary [1]. Through the use of technology, UT develops a distance learning system [2]. The development of ICT-based media is very much needed because of the very rapid advancement of technology that enables lecturers and students to apply ICT-based media. Learning media development needs to be done continuously, following the needs of students and the progress of the times [3]. Learning media using e-learning can be in the form of instructions delivered through digital media such as computers or mobile devices to support learning [4]. E-learning can develop 21st-century competency skills [5], improving ICT literacy skills [6], improving process skills [7], increase HOTS [8], and increase activity and effectiveness of learning [9]. One of UT lecturers' opportunities to innovate and take advantage of ICT in the Education Statistics course [10].

The objectives of the Education Statistics Subject are required to apply statistics in daily problems. Based on the observations on UT students in 2019.1 and 2019.2, it is concluded that 1). The students’ achievement in the education statistics subject was lack, 2). many students could only absorb theory but did not apply it in learning, 3). There is no e-learning for educational statistics subject matter which holistically helped students learned independently. So, development and innovation are needed in the Education Statistics subject.
One of the learning innovations by utilizing the LMS (Learning Management System). Besides, Web-based LMS is intended to facilitate access to learn the materials anytime and anywhere [11], it is highly structured and efficient task management [12], and it could foster students’ critical thinking through discussion forums [13] it could be documented coherently [14]. Many studies had been carried out related to Schoology-based e-learning, the results of which generally had a positive impact on learning. Schoology-based e-learning media made students more motivated [15]. It influenced better learning outcomes than students who used conventional ones [16]. The problem in this study is how to develop valid learning media in the Education Statistics subject. In conclusion, it is necessary to develop Schoology-based e-learning media in the Education Statistics subject.

2. Methods
This current research employed to research and development, which is the development of teaching materials in Education Statistics subject. The teaching materials were developed, including e-learning media based on Schoology in the Education Statistics course. The subjects of this study were the students in Kendal District who had taken the Education Research Statistics course. The development model used is the 4-D model from Thiagarajan, Semmel, and Semmel, such as; define, design, develop, disseminate [17], which is simplified into 3 stages, namely define, design, develop. The disseminate stage will be carried out at a later stage.

3. Results and Discussion
Thiagarajan, Semmel, and Semmel's development models consisted of define, design, and development. The stages of developing e-learning media can be described as follows.

3.1. Definition stage
This definition stage analyzes the characteristics of UT students, tutorial implementation, and the characteristics of the Education Statistics material. Through a combination of these three characteristics, the material in the learning media could be more complete. The characteristics of UT students were mostly already teaching so they wanted independent and flexible learning. The UT student face-to-face tutorial lasted 8 times. Based on that, the design of this learning media consisted of 8 stages with 9 modules. Each stage was adjusted to the characteristics of the meeting such as in meetings 3, 5 and 7, there were tutorial assignments.

Based on the results of observations and interviews, many students had difficulties in learning the Education Statistics material because 1) There were several educational statistics subject materials that had never been obtained by high school students, namely research hypothesis testing (z test, t-test, F test, $\chi^2$ test), regression analysis, and correlation and its application. 2). In the Education Statistics material, there were many tests, including the z test, t-test, F test, and $\chi^2$ test along with their respective tables and curves. This made students unable to distinguish when to use the z test, t-test, F test, and test. $\chi^2$ in problem-solving. 3). There were many formulas such as finding the average, mean, median, mode, quartile, decile, and percentile, and there were single and group data types. Based on the analysis of these three problems, an appropriate e-learning design was made.

3.2. Design stage
The next stage is designing Schoology-based e-learning media. The learning media in the Education Statistics course were designed according to the characteristics of the Education Statistics subject, the characteristics of UT students, and tutorial meetings. The first step with material mapping. Mapping material on learning media can be seen in Table 1.
Table 1. e-Learning Mapping Design for Research Statistics Subject

| No. | Module                                      | Mind map | Material          | Assignment       | Discussion       | Evaluation |
|-----|--------------------------------------------|----------|-------------------|------------------|-------------------|------------|
| 1.  | Statistics Basic Knowledge                  | Learning video | Summary          | Individual assignment | Discussion room | Quiz       |
| 2.  | Tabular form presentation of data in        | Learning video | Summary          | Individual assignment | -             | Quiz       |
| 3.  | Diagram presentation of data in diagram    | Learning video | Summary          | Individual assignment | -             | Quiz       |
| 4.  | Size of concentration, location, and        | Learning video | Summary          | Individual assignment | -             | Quiz       |
|     | dispersion A measure of the slope and       |           |                   |                  |                  |            |
|     | taper of a normal curve                     |           |                   |                  |                  |            |
| 5.  | Normal curve and its functions              | Learning video | Summary and       | Individual and group assignment | Discussion room | Quiz       |
| 6.  | Other curve and their functions             | Learning video | Learning video summary and questions | Individual and group assignment | Discussion room | Quiz       |
| 7.  | Testing hypotheses                          | Learning video | Learning video summary and questions | Individual and group assignment | Discussion room | Quiz       |
| 8.  | Regression linear and correlation           | Learning video | Summary and       | Individual and group assignment | Discussion room | Quiz       |

The material mapping design was made according to the characteristics of each material in the module. These characteristics were adjusted to the content of the material, the level of difficulty, and the complexity of the material. In summary, it consisted of video lessons, summaries and questions, individual and group assignments, discussion rooms, quizzes. In the menu display, the material was designed according to the needs and made attractive and attractive. The database could display students who had logged in / entered the learning media system. An overview of learning media can be seen in Figure 1.

![Instructional Media Design](image)

The outline design of the media consisted of 3 stages, such as; pretest, material, and posttest. Before the tutorial begins, students were asked to work on pretest questions, the aim of which was to find out the students' initial abilities. The pretest questions consisted of 120 questions which were randomized by the system so that only 40 questions were done. The questions were randomized based on the order of the questions and multiple random choices. So, it was possible that no student was working on the same problem. This was also the same with the posttest questions. Through this system, students' abilities could be obtained properly and correctly.
In this design, the learning media was divided into 10 parts consisting of 1 part of the competency map and 9 modules. This competency map contained an outline of the course of the material from beginning to end, from modules 1 to 9. Through the competency map, students could find out the flow of the material. The strength of this competency map was that it contained a sequence of materials that students could master from beginning to end, from simple material to complex material.

In this section, the material for each module was made in more detail. Each module contained a concept map, material, evaluation, discussion space, and assignments. The concept map created a learning video related to the module. This learning video contained an initial description of the material to be studied in the module. By using instructional videos, it was hoped that students understood it more easily and quickly. The material contained summaries in pdf form. This could be used by students for independent study. This material also contained sample questions to facilitate student understanding. Each module also contained an evaluation. In this evaluation, the student's ability for each module could be measured. The discussion room was used as a forum for student communication and interaction in one module. The database could also display student activities in studying existing material. Other abilities could also see how long students studied the material and when to study it. Based on this, it could be used to analyze students’ activities. Schoology-based e-learning media could provide opportunities for students to interact with lecturers. This is in line with the research [18]. Interacting with students and lecturers was a major important factor in learning. Through this media, it could provide opportunities for students and lecturers to interact online and offline.

The material grouping was also based on the characteristics of face-to-face tutorial meetings. UT students' face-to-face tutorial lasted 8 times. Each stage in this media also included a concept map and a summary of the material. This learning media contained sample questions and practice questions that students could use to hone their skills. This media design with a combination of online and offline because it was more effective in improving their learning performance compared to face-to-face meetings only or completely online learning [19,20].
3.3. Develop stage

At this stage of development is expert validation. At the expert validation stage, 3 experts are used, namely evaluation experts, statistics experts and learning media experts. The results of the validation can be seen in the Table 2.

Table 2. Expert validation result on instructional media

| No. | Validator | Skills             | Results |
|-----|-----------|--------------------|---------|
| 1   | Validator 1 | Evaluation         | 4.1     |
| 2   | Validator 2 | Statistics         | 4.0     |
| 3   | Validator 3 | Instructional Media| 4.2     |

Average: 4.1
Category: Very Valid

The results of the evaluation expert validation with a value of 4.1, the validation of the statistics expert with a value of 4.0 and the validation of the learning media expert with a value of 4.2. The average expert validation was included in the very valid category. After carrying out expert validation, it was continued with the learning media readability test. The readability test was carried out twice with an average result of 87% which was included in the very good category. Based on the results of the development, it was found that valid learning media can be used in lectures.

4. Conclusion

To sum up, the development of Schoology-based e-learning media has been implemented according to the development stages of Thiagarajan, Semmel, and Semmel with the following stages: 1). This definition stage analyzes the characteristics related to UT students, tutorial implementation, and the characteristics of the Education Statistics material 2). The design stage, in general, the e-learning media is designed to have a concept map, material in the form of video and pdf, student assignments, discussion forums, and evaluation 3). The development stage of the evaluation expert validation with a value of 4.1, the validation of the Statistics expert with a value of 4.0 and the validation of the learning media expert of 4.2. The average expert validation is included in the very valid category. The readability test was carried out twice with an average result of 87%, which was included in the very good category. Therefore, this current research reveals the Schoology based e-learning is momentous media in the pandemic situation, which can motivate the students to learn statistics respectfully and enjoyably.

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