Development of e-learning based media in economic mathematics course to increase students' reliance

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Abstract. This study aims to develop e-learning based media in Economic Mathematics courses to increase students' Reliance. This research is a descriptive research with a quantitative approach that refers to the development steps by Borg & Gall's, including: (1) research analysis, needs assessment and proof of concept; (2) product planning and design; (3) preliminary product & development; (4) preliminary field testing; (5) product revision; (6) main field testing; (7) and the final product revision and dissemination. Data collection techniques used is through documentation, interviews, observation, and tests. Data analysis technique is done by descriptive analysis of quantitative and qualitative (mixing method). From the results of the research, the results obtained in the form of a set of learning in the form of the lesson plan, students' worksheets and e-learning based media that fall into either category after validation by the material expert and media validator. The average score of the validator rating is 3.71 (lesson plan), 3.72 (students' worksheets) and 3.35 (e-learning based media). Furthermore, the device that has been formed will be applied in the field that is on the mathematics of economics at fifth-semester students in the academic year 2017/2018 Mathematics Teaching Department of Universitas PGRI Madiun. Implementation of learning devices is done to determine the practicality and effectiveness of e-learning based devices developed, and to determine the extent to which the device can increase student self-reliance.

1. Introduction

Advancement of Science and Technology today requires us always to follow the changes that occur as always. It certainly becomes one of the most important things for the realization of the progress of a nation. Hopefully, we will not be left further with other nations. Utilization of science and technology in various fields is expected to be able to support the achievement of the goals of the nation itself.

Education is one of the areas which has a big contribution to the achievement of the goals of a nation. Advancement of Science and Technology today requires us to follow the changes, include in the education world. It is certainly one thing that must be done as one consequence for the achievement of learning objectives become more practical and easy.

Along with the purpose of national education in Indonesia, of course, the mastery and utilization of Science and Technology field become one of the priority. This is in line with the Indonesian National Qualifiers Framework (KKNI), where one of the competencies that must be owned by bachelor degree students can apply the field of expertise and use science and technology in the field in problem-solving and able to adapt to the situation faced.

Various problems are often found during the implementation of classroom learning activities. One of them is the problem of student presence characters. Students tend to rely on explanations submitted by lecturers, resulting in their creativity become less able to be explored. Though nowadays a new paradigm of education that requires the implementation of innovations that are integrated and sustainable, which can grow the character of student Reliance. Where the character of Reliance can be one important factor in supporting the success of students. This is in line with the conclusion of a study which states that the development of socialization skills and integration of character education is an important part of a child's academic success [1]. One form of innovation that can be done is through the utilization of information technology as a medium of learning.

E-learning-based media is one example form of utilization of Information and Communication Technology. Through this media, it is expected to be able to help smoothness in the learning process conducted by a lecturer. Lecturer professionalism includes not only the ability to teach students, but also the ability to manage information and environment (which includes learning places, methods, media, appraisal system, and facilities and infrastructure) to facilitate student learning activities so that it becomes easier [2].

Through the using of E-learning-based media, it is expected to make the students more independent. This means that students are more active and creative in every learning activity that is implemented. This is in line with the opinion that E-learning-based media, which states that the learning tools created can cultivate the creativity of students, which in turn will shape the character of students (including honest, disciplined, responsible and independent) [3]. Also, effective implementation of e-learning can border the educational opportunities and enable students to develop the skills they need for the 21st century [4].

Economic Mathematics course is one of the subjects undergraduate students of mathematics education at Universitas PGRI Madiun (UNIPMA) in the fifth semester. So far in the lecture activities undertaken, lecturers are still not much use of e-learning based media. Lecturers tend to use powerpoint media only to help them in delivering the materials. Therefore it will be developed an E-learning-based media that is expected to contribute to the creation of a more enjoyable learning atmosphere and able to grow student self-sufficiency Reliance, thus impact on success in the learning process itself.

2. Methods

The type of this research is R&D that develops learning tools including Semester Unscrupulous Plan, Student Activity Sheet, and e-learning based media. The steps to follow Borg & Gall's (2003) are as follows: (1) research analysis, needs assessment and proof of concept; (2) product planning and design; (3) preliminary product & development; (4) preliminary field testing; (5) product revision; (6) main field testing; (7) and the final product revision and dissemination [5].

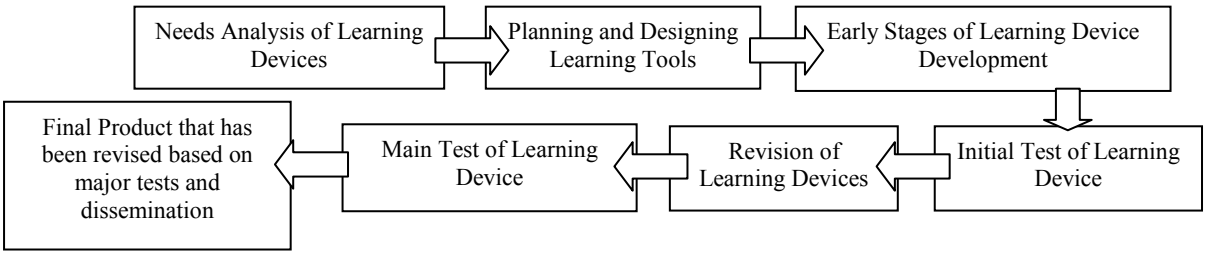

Figure 1. Chart of Borg & Gall's developmental steps (2003)

Based on Figure 1, the research steps with development can be clarified by the following.

Table 1. Details of Research Activities

Type of activity	Details of activities
Needs analysis for e-learning based learning devices	1. Analysis of condition of mathematics education facilities 2. Analysis of the condition of the ability of lecturers and students to the use of ICT 3. Analysis of lecturers' ability about using e-learning based media 4. Reference search 5. Analysis of learning situation of Economic Mathematics
Plan and design e-learning based learning device	1. Plan and design syllabus and RPP through FGD 2. Plan and design LKMs through FGDs 3. Plan and design e-learning based learning media through FGD 4. Plan and disseminate instrument validation of expert and user of learning media based on e-learning through FGD 5. Plan and disseminate the response instruments of lecturers and students through FGD
The early stage of development of e-learning based learning device	1. The initial draft of syllabus and RPP 2. The early draft of the LKM 3. The early draft of e-learning based learning media
Initial test (small scale) e-learning based learning device	1. Validation of expert e-learning based learning device 2. Validate small-scale users 3. FGD results of expert and user validation
Revision of e-learning based learning devices	Revisions by: 1. Validation by e-learning tool-based learning expert 2. Validation by small-scale users
Main Test (large scale) e-portfolio model	1. Applying e-learning based learning tools to the Mathematics of Economics course 2. Evaluate the results of the application of e-learning based learning devices through FGD, if declared eligible by experts then continued decimation
Final Product that has been revised based on the main test and dissemination	Multiplication of final product and dissemination at the level of mathematics education program

3. Results and Discussion

The results of the implementation of this research activity are described for each stage of development of learning tools as follows:

3.1. Research analysis needs assessment and proof of concept

The initial stage in this research is requirement analysis for E-learning-based media. Currently, Mathematics Education Studies Program at UNIPMA already has supporting facilities in the learning activities of mathematics, not least learning with the utilization of the internet. The Study Program has a computer laboratory that has been connected to the internet and also available wi-fi service that can be accessed by lecturers and students. It is of course very supportive of the learning process activities that will utilize the internet network in it.

Advances in information technology today certainly does not prevent anyone to learn more broadly with the ease offered in it, not least for lecturers and students. E-learning-based media is still not well known by lecturers and students in Mathematics Education Program. By having their understanding in the field of information technology, it is believed will not be too hampered in the use of e-learning

based media. Thus expected through the utilization of the media will be able to support the smooth running of teaching and learning process. Also, the application of technology is used to help to learn and increase knowledge. This can be done by integrating technology into science and mathematics [6].

To support the learning activities in the Study Program, Currently, Mathematics Teaching Department has a library which provides references to support lecture activities for lecturers and students. The latest output books are provided in Study program's library. Surely the availability of various references to this book as supporting references will also be very supportive lecture activities are held.

3.2. The product's planning and design

Planning and design of Lesson Plan follow the provisions applicable to the UNIPMA. The lesson plan contains biodata, course descriptions, learning achievements, final planned capabilities, materials, learning methods, time allocation, appraisals, library resources, and so on.

Development of Student's Worksheet is organized with a focus on group discussions (FGD). The LKM is planned to be prepared by loading some of the content including 1) Material delivery room; 2) Example chamber; 3) Exercise Room.

In addition to RPS and LKMs, also will be developed an e-learning based media that is expected to be able to train student self-reliance. Through the media is expected to be a means of communication for lecturers and students wherever they are (meaning can be run not necessarily during lecture hours). However, it does not mean that learning is done without having face to face. E-learning courses should be mixed between face to face and e-learning in the appropriate solution. After students had learned through e-learning, they had developed courses in other courses [7].

Based on the three devices that will be developed above, next will be validated by the material and media experts. Besides, it also will be prepared a questionnaire of students' response to media that has been developed. Some of the instruments to be used in this study include (1) Learning Device validation sheets; (2) student activity observation sheets; (3) sheets of observation of learning management by lecturers; and (4) questionnaire to find out student response to learning.

3.3. Preliminary product & development

At this stage, the development of early stages of learning devices based on e-learning. Initial development is done by making the prototype of learning tools that include a lesson plan, students' worksheets, and e-learning based learning media.

The lesson plan is designed based on Focus Group Discussion (FGD) -oriented learning. Learning is focused on group discussions, in the hope that students can work together in understanding the course material. This is shown in the learning activities that use the model of learning in groups. Meanwhile, the students' worksheets are prepared by loading some contents including 1) Material delivery room; 2) Example chamber; 3) Exercise Room; and 4) Evaluation Room. While the e-learning based media developed by using PHP-based programs. PHP is a server-side script programming language designed for web development. Initially, PHP stands for Personal Home Page but now stands for PHP: Hypertext Pre-processor which is a recursive extension, the word game where stands consist of the abbreviation itself: PHP: Hypertext Pre-processor. E-learning based media developed, can be used by lecturers and students to support lecture activities. Media that developed include some contents, such as lecture materials, schedules, assignments, quizzes and communication facilities between lecturers and students.

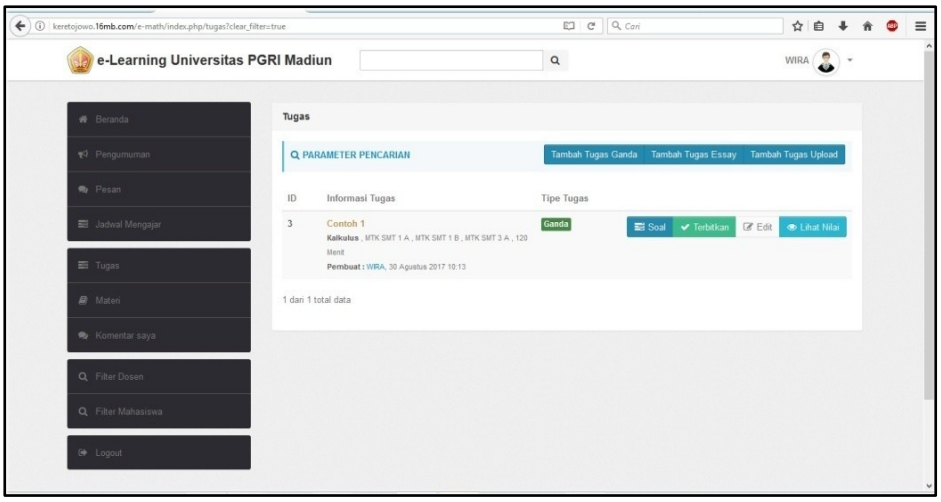

Figure 2. Example of the developed e-learning display

3.4. Preliminary field testing

Activities undertaken at this stage are the study and feasibility assessment of learning tools that have been developed by validators which in this case will be assessed by two material experts and one media expert. Validation results that have been done by the three validators, described as follows:

3.5. Results of RPS Validation

The results of the assessment by two material expert validators on RPS developed by the researchers are described in Table 2 below.

Table 2. Results of RPS Validation

No	Assessment Aspect	The average of both validators
Content Presented		
1.	Assess the interconnection between Competence standard (SK) and Basic Competence (KD) in the course	3.38
2.	Identify materials that support the achievement of KD	3.63
3.	Selection of teaching materials	4.00
4.	Learning activities are designed and developed based on SK, KD, student potential	3.85
5.	Formulate indicators of achievement of competence	3.50
6.	Determining learning resources tailored to SK, KD, as well as subject matter, learning activities and indicators of achievement of competence	3.70
7.	Determination of assessment type	3.75
Language		
1.	Use of language following EYD	3.80
2.	The simplicity of sentence structure	3.75
Time		
1.	Appropriateness of allocations used	3.75
2.	The choice of time allocation is based on basic competence demands	3.68
3.	Selection of time allocation is based on the availability of time allocation per semester	3.78

From the results of the validation of the syllabus shows that each component on the validation sheet obtained an average of more than three, and the overall average is 3.71. It shows that the result of the validation of the syllabus is in a good category, so it is worthy to be used in the learning.

3.6. Students' Worksheets Validation Results

The results of the assessment by two material expert validators for students' worksheets developed by the researchers are described in Table 3 below.

Table 3. Results of students' worksheets Validation

No	Assessment Aspect	The average of both validators
Format		
1.	Clarity of material distribution	3.88
2.	It has appeal	3.70
3.	The numbering system is clear	3.78
4.	Conformity between text and illustration	3.50
5.	Space settings/layout	3.63
6.	The type and size of the letters are appropriate	3.83
Language		
1.	The truth of grammar	3.95
2.	Conformity of sentences with the level of thinking and ability of students	3.88
3.	Guidance clarity and direction	3.90
4.	The simplicity of sentence structure	3.78
5.	Encourage reading interest	3.58
6.	Sentences do not contain a double meaning	3.83
7.	The communicative nature of the language used	3.63
Illustration		
1.	Support illustrations to clarify concepts	3.13
2.	Have a clear view	3.73
3.	Easy to understand	3.83

Table 3 above shows that the three validators provide an assessment for each component obtaining an average of more than 3 and the overall average earning 3.72 in either category. It shows that the components in the students' worksheets are well-rated and worthy of use in learning with some improvement.

3.7. E-Learning Based Media Validation Results

The results of the assessment by expert validators of e-learning based media that have been developed by the researchers are described in table 4.

Table 4 shows that the validator assesses each component obtaining an average of more than 3 and an overall average of 3.35. It shows that the developed e-learning media components get a good judgment and are worthy of use in learning with some improvements. However, there are some aspects that scored less, i.,e. Aspects number 11 and 13. This is because the media developed does not feature audio and video elements.

Table 4. Results of Media Validation Based on E-Learning

No	Rated Aspect	Score
1.	Maintainable (can be maintained / managed easily)	4.00
2.	Reusability (simple to use and simple in operation)	4.00
3.	Compatibility (learning media can be installed/run on various existing hardware with or without downloading material)	3.75
4.	Complete media documentation	3.75
5.	Reusable (can be reused)	3.00
6.	Communicative	3.75
7.	Creative in the following ideas casting ideas	4.00
8.	Simple and alluring	4.00
9.	Interactivity	3.50
10.	Giving the motivation to learn	3.00
11.	Audio (narration, back sound, and sound effect)	1.00
12.	Visual (layout design, typography, color)	3.75
13.	Moving media (video)	2.00
	Total Score	**43.50**
	Average	**3.35**

3.8. Product revision

Based on the previous stages, next steps are revised against the device that has been developed. Revisions are based on inputs by validators. Some of the revisions made include:

- **Lesson Plan**: use of measurable verbs in formulating indicators of achievement of competencies; learning resources are written by planned learning activities; improvement in writing errors
- **Students' worksheets**: Problems of assignment and evaluation are made more and varied; Repair mistakes in typing; Content issues are associated with daily life
- **E-Learning based media**: Logo replacement; Revision of some words or sentences that are still wrong

3.9. Main field testing

From the results of e-learning based devices that have been developed and validated by expert validators, then will be applied to the Mathematics lectures Economics. The application will be held in the semester of the academic year 2017/2018, in the fifth semester which began in September 2017. The class will be used for the pilot class 5A with a total of 30 students. From the results of these trials, will be evaluated through the spread of questionnaire responses of students to the use of e-learning media that has been developed. If obtaining a positive response, then the e-learning based media that has been developed will continue with the dissemination at the level of Mathematics Teaching Department

3.10. The final product revision and dissemination

The last stage of this development activity is the latest revision based on limited test results and further disseminated at the Mathematics Teaching Department level. However, this is discouraged for further research activities.

4. Conclusions

Based on the description in the previous chapter, it can be concluded: 1) Produced learning tools in the form of lesson plan, students' worksheets and e-learning based media that will be used to foster students' Reliance; 2) The resulting device has been validated by the validator and meets the criteria well with the average score 3.71 (lesson plan), 3.72 (students' worksheets) and 3.35 (media e-learning), so it is worth to be tested.

Some suggestions are given in this research, namely: (1) Learning tools are still needed to be tested in the university to know the level of effectiveness and practicality, so as to obtain learning tools that are really qualified; (2) The need for preparation and design is quite mature in implementing each learning device developed, so that the learning objectives can be achieved optimally.

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