



E-Module of Mathematics Economic Using Heutagogy Approach for Distance Learning: Is It Effective?

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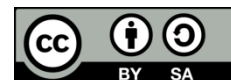
ABSTRAK

Pendekatan heutagogy merupakan pengembangan dari pembelajaran andragogi yang menitikberatkan pada kemandirian belajar siswa. Pendekatan ini dapat digunakan sebagai alternatif pembelajaran jarak jauh. Untuk mendukung proses pembelajaran, diperlukan e-modul berbasis heutagogy. Oleh karena itu, tujuan dari penelitian ini adalah untuk mengembangkan dan menganalisis keefektifan E-Module Matematika Ekonomi Berbasis Pendekatan Heutagogy dalam pembelajaran jarak jauh. Desain penelitian yang digunakan model 4-D terdiri dari tahap define, design, develop, dan disseminate. Uji efektivitas E-modul menggunakan penelitian eksperimen dengan one group pre-test-post-test design dan melibatkan 66 mahasiswa program studi Pendidikan Ekonomi sebagai responden. Pengumpulan data menggunakan instrument kuesioner kemudian dianalisis menggunakan Kolmogorov-Smirnov Normality test dan Wilcoxon signed-rank test. Hasil penelitian ini mengungkapkan bahwa: 1) E-modul matematika ekonomi menggunakan Pendekatan Heutagogy layak digunakan sebagai media pembelajaran, 2) terdapat pengaruh penggunaan E-modul Matematika Ekonomi dengan Pendekatan Heutagogy dalam Pembelajaran Jarak Jauh. E-modul dapat meningkatkan hasil belajar siswa dan membantu mereka untuk belajar secara mandiri selama pembelajaran jarak jauh. Disarankan bagi penelitian selanjutnya untuk menganalisis variabel lain seperti kemampuan berfikir kritis dan kemampuan logika matematika mahasiswa.

ABSTRACT

Heutagogy approach is the development of andragogy learning which focuses on students' self-determined learning. This approach can be used as an alternative for distance learning. To support the learning process, an e-module based on heutagogy is needed. Therefore, the purpose of this study was to create and analyze the effectiveness of E-Module in Mathematics Economic based on the Heutagogy Approach in distance learning. Research design used 4-D model consists of define, design, develop, and disseminate stages. Examining the E-module effectiveness was using experiment research with one group pre-test-post-test design which involved 66 students of Economics Education as participants. Data collection are carried out with questionnaire and analyzed with several test, namely: Kolmogorov-Smirnov Normality Test, Wilcoxon signed-rank test. The results of this study revealed that: 1) E-module of mathematics economic using Heutagogy Approach feasible as learning media, 2) there is an effect of using E-module of Mathematics Economic using Heutagogy Approach for Distance Learning. E-module can increase students learning outcomes and helps them to study independently during distance learning. For future research, it is suggested to analyze another variables, such as: students' critical thinking skills and students' logical-mathematical thinking ability.

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1. INTRODUCTION

Along with the advance of technology, learning process is not only on face-to-face learning mode, but but also on distance learning mode. Generally, distance learning can be interpreted as learning process that utilizes technology. This learning mode requires technology during learning process to help students study anytime and anywhere they want (Oliveira et al., 2018; Sadeghi, 2019). The application of distance learning has several advantages, namely: 1) Numerous media can be used to support distance learning process such as Whatsapp Group, Edmodo, Google Classroom, etc., 2) study from anywhere, 3) saving time, and 4) flexible. On the other hand, distance learning also has several disadvantages, such as: 1) it requires some advance technology, 2) difficult to staying in contact with instructor, 3) stable internet connection, 4) and lack of social interaction (Arasaratnam-Smith & Northcote, 2017; Sadeghi, 2019). In addition, distance learning also requires student's responsibility to study and regulate their study independently (Pelikan et al., 2021; Rozi et al., 2021). If students

do not have independent learning, distance learning process cannot run well. Therefore, a learning approach which suitable for distance learning characteristic is needed.

Heutagogy approach is an alternative to overcome distance learning problems (Anderson, 2010; Blaschke, 2012). Distance learning is a suitable condition to create a learning environment that supports a heutagogy teaching and learning approach where the independence and cognitive maturity of students are needed to decide what and how to learn (Bansal et al., 2020; Hiryanto, 2017). In addition, heutagogy approach also known as a potential theory which is suitable for online and distance education using technology assistance (Agonács & Matos, 2019; Blaschke, 2012; Lynch et al., 2021). Heutagogy is the development of andragogy which focuses on self-determined learning (Blaschke & Hase, 2016; Mohammad et al., 2019). Self-Determined Learning is a process which students assumes responsibility to control their learning activities such as formulate learning objectives, identify learning resources, implement problem solving strategies, and skill to enhance learning experience to achieve their personal goals (Loeng, 2020; Morris, 2019). Some previous research revealed that heutagogy approach implementation encourages students to be more engage in the learning process (Abraham & Komattil, 2017; Widiaty et al., 2020). In addition, learning using a heutagogy approach increases students' intrinsic motivation in learning (Glassner & Back, 2019; Richardson et al., 2018).

Mathematics course is one of the challenging subject faced by students because in this course require understanding theory, practice, and mathematic logical (Tarteer & Ismail, 2020; Wahyuddin, 2017; Zeidmane & Rubina, 2017). Moreover, in Economic Education study program, Mathematics Economic is a mandatory course that should be taken by first year students. Most of students revealed that they experienced learning difficulties on this course during online learning because of the course characteristics which implement Mathematics concept on Economic field. Therefore, it is required to create a learning media to help students study independently on Mathematics Economic course. However, there is lack of module in mathematics economic courses using heutagogy approach to support distance learning. In addition, the mathematics economic course is a subject included in the curriculum of all study programs at the Faculty of Economics and Business, Universitas Negeri Surabaya. Thus, it is essential for students to mastery this subject. Thus, it is pivotal to create an e-module on Mathematics Economic subject which provide various future to guide students to manage their learning process. This research focuses on the Development of an Mathematics Economic E-Module Based on the Heutagogy Approach in distance learning. The mathematics economic course is a subject taught in the first semester and is a basic course based on several subsequent courses such as macroeconomic theory, microeconomic theory, and econometrics.

Several studies related to the heutagogy approach on learning process have been conducted by are considered effective in independent learning of students including research conducted by (Anand et al., 2021; Jazeel, 2016). However, both of these research examined the heutagogy approach on Science field. Therefore, this study aims to contribute to enrich heutagogy literature especially its implementation on social course. Novelty in this research is developing e-module of mathematics economic based on the heutagogy approach in distance learning which is including several important elements in designing the heutagogy process, namely: (a) explore; (b) create; (c) collaborate; (d) connect; (e) share; (f) reflect (Blaschke & Hase, 2016; Mohamad et al., 2020). Specifically, this e-module equipped with interactive video which can help students study independently. Thus, it is expected to encourage students' cognitive maturity. The purposes of this study to: 1) Create an E-Module in Mathematics Economic Based on the Heutagogy Approach in distance learning using the 4-D Thiagarajan model; 2) Analyze the effectiveness of E-Module in Mathematics Economic Based on the Heutagogy Approach in distance learning.

2. METHOD

This research types are Research & Development and experimental research. Mixed Methods are used as an approach in this study, namely quantitative and qualitative. The first research procedure was to conduct Research & Development research using the 4D Model from (Thiagarajan, S., Semmel, D.S., & Semmel, 1974) to produce an E-Module of Mathematics Economic Based on the Heutagogy Approach. The next procedure is examining the effectiveness of using the E-Module of Mathematics Economic Based on the Heutagogy Approach through experimental research with one group pretest-posttest design. The subjects or respondents involved in this research were 66 students of Economics Education study program who took Mathematics Economic course. The data collection method used a questionnaire (Siregar, 2014). There are several questionnaires including: 1) A questionnaire with a choice of 5 Likert scale instruments was used to obtain peer-reviewed and validated information from three experts, namely learning materials experts, media experts, and linguists; 2) Questionnaires with the Guttman scale instrument were used to analyze student questionnaires; 3) Questionnaires in the form of pretest and posttest were used to measure the effectiveness of using Heutagogy-

Based Economic Mathematics E-Module. The method of data analysis in development research is done by changing the percentage of each component of the questionnaire using the criteria as shown in Table 1.

Table 1. Eligibility Score Criteria by The Experts and Students

Score	Criteria
81%-100%	Excellent
61%-80%	Good
41%-60%	Satisfy
21%-40%	Not feasible
0%-20%	Poor

(Riduwan, 2012)

The weakness of the 4D model is no evaluation stage (Maydiantoro, 2021). While the evaluation is aims to measure the quality of the product. Therefore, to examine the effectiveness of e-module, researchers used experimental research with one group pretest-posttest design (Sugiyono, 2017). Before measuring the effectiveness level of using e-module on learning outcomes, it is necessary to conduct a normality test. The normality test used to determine whether the data were normally distributed in two paired samples. Kolmogorov-Smirnov Normality Test is a test conducted to determine the distribution of random and specific data in a population with statistical hypotheses: a) Ho: normally distributed data; b) Ha: data are not normally distributed. Decision making is based on the significance value (p) on the Kolmogorov-Smirnov test. If the significance value of $p > 0.05$, then Ho is accepted and vice versa (Nuryadi et al., 2017; Siregar, 2014). If the data is normally distributed, the effectiveness test uses the paired t-test. Meanwhile, if the data are not normally distributed, the effectiveness test uses the Wilcoxon signed-rank test. Decision making for paired t-test is seen from the probability value of p value. If the p value > 0.05 then Ha is accepted (Nuryadi et al., 2017; Suyanto & Gio, 2017). The decision-making criteria of the Wilcoxon test was Ha was accepted if Wilcoxon signed-rank Test result showed that asymp. Sig value (2-tailed) $0.000 < 5\%$ and vice versa (Nuryadi et al., 2017; Suyanto & Gio, 2017).

3. RESULT AND DISCUSSION

Result

Developed product characteristics

The curriculum used in this study accordance to Economics Education Study Program curriculum on Universitas Negeri Surabaya. Based on the curriculum, there are several materials that will be developed in the E-Module of Mathematics Economic Based on the Heutagogy Approach. These learning materials include several topics such as: 1) implementation of series concept in economics; 2) Linear functions in microeconomics and macroeconomics; 3) non-linear functions and their application in economics; 4) differential and integral concept and its application in economics. The students who participated in this research were first year students of Economics Education Study Program. Based on the gender analysis, students' proportion were dominated by female students. The average age of these students is between 18-19 years. Students' previous educational background come from senior high school (including social sciences major, natural sciences major, and language major) and vocational school. Thus, their basic mathematics abilities also diverse. For students who come from high school, on average, they already studied the concepts of mathematics, both series and sequences, linear functions, nonlinear functions, differentials, partial differentials, and integrals on high school. Meanwhile, for some students who come from vocational schools, most of them are not familiar with non-linear, partial differential, or integral functions.

Based on the results of the classroom assessment through pretest session, it showed that there was no significant difference between students' learning outcomes. The basic abilities of mathematics economic in the students of Economics Education Study Program are varied. With a percentage of 50% of students with scores above 50 and 50% of students having abilities below 50 out of a total score of 100. Furthermore, based on researchers' observation, students experienced learning difficulties in mastering basic concepts Mathematics Economic. Most of students are not confident in developing their abilities and maximize existing learning resources to solve case studies. Thus, learning objectives are not achieved. In addition, students always depend on lecturer' explanation. Learning activities are focused on students' independence to control their ability to mastery learning material based on their learning pace. The development of a Mathematics Economic E-Module Based on the Heutagogy Approach is directed at the ability and skills to solve case studies in the mathematics economics. It also includes several elements as students guide, namely: (a) explore; (b) create; (c) collaborate; (d) connect; (e) reflect; (f) share. The development of the Mathematics Economic E-Module is intended to assist

students in the learning process to study independently, maximize learning ability and pace, and utilize various existing learning resources to achieve learning objectives. This E-module enriched with various case study to improve students' problem-solving and collaboration skills. Students are possible to discuss and sharing knowledge with their peers during learning process. In this stage is aims to design E-Module of Mathematics Economic Based on the Heutagogy Approach. The E-Module consists of several parts including: cover; opening section; learning contract; learning activities, learning outcomes, and closing section. Some figures of the developed products are presented on Figure 1, Figure 2, Figure 3, and Figure 4.

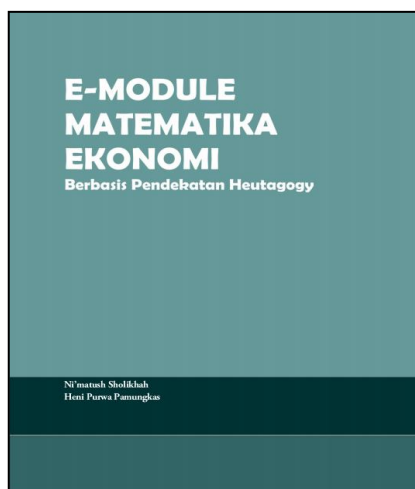


Figure 1. Cover E-Module



Figure 2. Opening Section

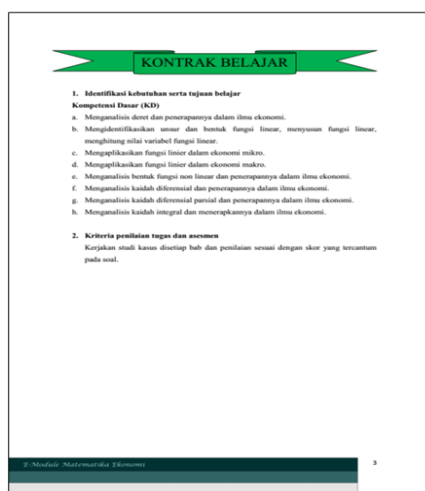


Figure 3. Learning Contract

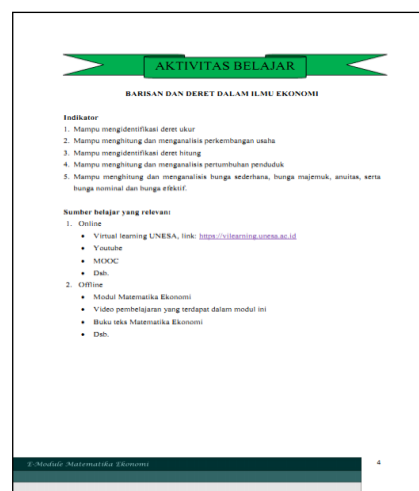


Figure 4. Learning Activities

The result of validity test

The results of validity divided into two types, namely: 1) expert appraisal; and 2) Developmental Testing. Expert appraisal obtained through Instruments for review and validation content consist of three aspects, including: linguistic aspect, learning material aspect, and media aspect. The instruments sheet used five answer choices based on a Likert scale from 1 to 5. 1 represented the most unlikely choice and 5 for the most likely choice. The results of validity test through experts appraisal is presented in Table 2.

Table 2. Content Validity Instrument

No.	Experts/Aspect	Score/Percentage
1	Content	66%
2	Media	87%
3	Linguistic	88%

Based on Table 2, the result of peer-review and validation by the experts showed that E-module obtained excellent marked (got 88% score) for linguistic aspect. It means that E-module was written grammatically correct. Then, the validation assessment from the experts on the e-module in general is 66% which categorize as good marked too. Moreover, the assessment of media aspect obtained a score of 87% which can be interpreted as excellent category. As a conclusion, the development of E-module Mathematics Economic feasible to be used as learning material supplement. The results of linguists peer-review, there are several suggestion: foreign terms should be typed in italics mode, prohibited to use conjunctions at the beginning of sentences, improving coherent sentences in a paragraph, using formal language, using constant greeting words, and revising the numbering. The results of material peer-review suggest to: complete mind map in each chapter, add case studies based on Higher Order Thinking Skills or HOTS in each chapter, improve the learning material in each chapter based on existing theory, and add reference sources to this e-module. As for the results of peer review by media experts, it is suggested to add relevant images on e-module cover. All of suggestion have been revised by the author.

Practicality test

Practicality test aimed to analyse students' response after using e-module as their learning media through student responses questionnaire. This questionnaire used Guttman scale for data analysis. The results of student responses were analyzed descriptive quantitatively by using the percentage of each component results. The results of student responses obtained the following data: 1) on the material aspect, a score of 97% was obtained with excellent criteria; 2) in the presentation aspect, a score of 94% was obtained with excellent criteria; 3) on the language aspect, a score of 98% was obtained with excellent criteria; 4) on the graphic aspect, a score of 90% was obtained with excellent criteria.

Effectiveness test

To examine the effectiveness of the researchers used experimental research with one group pretest-posttest design. The results of the data normality test with Kolmogorov-Smirnov are as shown in Table 3.

Table 3. Normality Test

Tes		Tests of Normality						
		Kolmogorov-Smirnov ^a			Shapiro-Wilk			
		Statistic	Df	Sig.	Statistic	df	Sig.	
Nilai	Pre	0.142	66	0.002	.955	66	0.017	
	Pos	0.175	66	0.000	.944	66	0.005	

a. Lilliefors Significance Correction

The significance value (p) in the Kolmogorov-Smirnov test is $0.000 < 0.05$, H_0 is rejected. Therefore, based on the Kolmogorov-Smirnov normality test, the data is not normally distributed. Due to research data are not normally distributed, researchers used nonparametric statistics with Wilcoxon test to measure students' learning outcomes through pretest and posttest scores. The result of analysis is presented in Table 4.

Table 4. Pretest-Posttest Score Analysis

Model	Statistics	N	Mean Rank	Sum of Ranks
posttest – pretest	Negative Ranks	5 ^a	20.20	101.00
	Positive Ranks	54 ^b	30.91	1669.00
	Ties	7 ^c		
	Total	66		

Table 4 represented the differentiated value between pretest and posttest. Negative rank means that there was decreasing score on posttest. There were 5 students who got post-test score lower than their pre-test score. Meanwhile, positive rank means that post-test higher than pretest score. In this case, 54 students got higher score on their post-test. Furthermore, ties rank means that pre-test and post-test score are equal. Only 7 students on ties category. Significant value of Wilcoxon test was 0,000 which lower than 0,05. It means alternative hypothesis that there is an effect of using E-Module of Mathematics Economic Based on the Heutagogy Approach on learning outcomes accepted.

Discussion

The results of the development of the e-Module in Mathematics Economic Based on the Heutagogy Approach obtained an e-module in the form of a pdf file. E-Module contains cover, opening section, Learning

contract, Learning activities, Learning outcomes, and closing section. In learning activities there are: Course learning outcomes explanation, Identify learning resources which can be learning support, Mind map as a learning material overview, Learning material explanation in written narratives and interactive videos. Interactive videos are used to clarify the explanation of the mathematical economics discussion to students. Furthermore, in the Learning outcome section, it was assessed by: Assignment and Students' ability in making decisions based on mathematics economic analysis.

The elements of the Heutagogy approach consist of (a) explore; (b) create; (c) collaborate collaborated; (d) connect; (e) share; (f) reflect (Blaschke & Hase, 2016; Mohamad et al., 2020) provided in the module. Element (a) explore, students are given the independence in choosing reference sources, whether in the e-module, or other suitable sources to be accessed and studied by students. Element (b) create, in the e-module guides students to complete various case studies according to the cognitive level of students. In this stage, students will determine their own learning pace to solve case studies in e-modules. They will be able to measure what level their cognitive abilities are at. They will be required to mature in thinking. Element (c) collaborates, divide students into several groups during learning process to solve case studies. With collaboration, students can interact with one another. Element (d) connect, encourage students to discuss, exchange opinions, sharing knowledge between groups. Moreover, students can maximize the Learning Management System owned by the campus, video conference or other forms of social media as media to discuss. Element (e) share, in this stage students can share knowledge from various points of view. They can present their cognitive point of view through appropriate presentation media. Element (f) reflects, encourage students to analyze and conclude case studies and their knowledge. They can reflect on the new knowledge they have gained from the results of the learning process. It aims to help students' knowledge from short term memory to long term memory (Blaschke & Hase, 2016; Lockey et al., 2021). Thus, this heutagogy concept can be used as lifelong learning (Kamrozzaman et al., 2020; Mohamad et al., 2020; Mohammad et al., 2019).

Developmental testing is analysed based on students' responses. The components of students' responses include: material aspect, layout aspect, language aspect, and graphics aspect. In general, students give positive feedback for E-Module implementation. Students' responses around 97% which can be interpreted as excellent criteria. In conclusion, E-Module of Mathematics Economic Based on the Heutagogy Approach is suitable for use in online learning. This result in line with previous research that implementation of e-module using heutagogy approach is suitable for online learning process (Gillaspy & Vasilica, 2021; Msila & Setlhako, 2012).

The results of the Wilcoxon Signed Ranks Test state that revealed that E-module has significant effect to improve students' learning outcome. The implementation of E-Module of Mathematics economic based on the Heutagogy Approach is able to encourage students more independent during learning process. Several elements of Heutagogy approach are included on E-module, namely: (a) explore; (b) create; (c) collaborated; (d) connect; (e) share; (f) reflect (Blaschke & Hase, 2016; Mohamad et al., 2020). This study in line with previous research which stated that the use of teaching materials in the form of e-modules based on the heutagogy approach can improve student learning outcomes by using technology (Anand et al., 2021; Jazeel, 2016; Kamrozzaman et al., 2020).

The elements of heutagogy approach on E-Module help students to understand their learning goals and strategy to achieve it based on their learning style. Moreover, several features to support students to study independently such as mind mapping, learning guidance, and case study are provided. Thus, students can learn autonomously and independently. In distance learning there are two types of interactions, namely asynchronous and synchronous learning (Alhih et al., 2017; Cahyani et al., 2021). In asynchronous learning, information provided by instructor and students can reach its information when they need. Therefore, students should determine learning resources that are relevant to the learning objectives. Students are able to measure their own abilities in the evaluation section in the E-module. In this section, some questions required students to collaborate in groups, they should interact and discuss in peers to solve the problems. Thus, synchronous learning occurs with the guidance of the lecturer becomes more active and increase students' engagement. Furthermore, they also required to reflect on the answers that were obtained in the synchronous class and to share their knowledge (Blaschke, 2014; Fabriz et al., 2021; Rinekso & Muslim, 2020). Then, at the end of learning, students process their new knowledge during learning activity from short term memory to long term memory. This heutagogy approach also maximize learning process by increasing students' metacognitive reasoning (Anand et al., 2021; Blaschke, 2014; Hase & Blaschke, 2021). The position of the lecturer in learning using the e-module heutagogy approach is as a learning facilitator (Akyıldız, 2019; Miller et al., 2018). Lecturers' role as partners with students in their learning process. Lecturers also give freedom to students to explore and expand the boundaries of learning (Hase & Blaschke, 2021; Segara et al., 2021). In conclusion, heutagogy approach encourage students' independence during learning process.

The weakness of this research is only focus on the e-module effectiveness and is not examined the level of students' Higher Order Thinking Skills and students' mathematical logical thinking abilities. Heutagogy

approach can stimulate students to learn independently and students' metacognition. Therefore, it is essential to analyze the effectiveness of this e-module.

4. CONCLUSION

The result of this research found that E-module feasible to use based on the review and validation of media experts, linguists, and material experts. Furthermore, most student give positive responses and said that E-module is very feasible to use. It also helps students to increase their learning outcomes. The result showed that there was an effect of using the E-Module in Mathematics Economic based on the Heutagogy Approach in distance learning on students learning outcomes. E-module enriched with some features which enables students to learn autonomously and independently. Students determine their own learning resources, measure their own abilities in evaluation section, either independently or in groups. Further research is suggested to focus on assessing students' higher order thinking skills (HOTs) and students' mathematical logical thinking abilities trough E-Module of Mathematics Economic based on the Heutagogy Approach.

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