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Interactive E-Modules: Revolutionizing English Learning for University Students in the IR 4.0 Era

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ABSTRACT

The world is presently undergoing a fourth industrial revolution. Artificial intelligence, supercomputers, genetic engineering, nanotechnology, autonomous transportation, and innovation. This study investigated the impact of an interactive E-module as an innovative English learning tool for D3 Dental Engineering students during the Industrial Revolution 4.0. This study employed a quasi-experimental methodology, incorporating both experimental and control groups. The sample consisted of 56 students, including first-semester students from the D3 Dental Engineering and D3 Midwifery programs, totalling 28 students. The findings demonstrated that the implementation of interactive E-modules as an innovative approach to English learning during the Industrial Revolution 4.0 era had a significant effect, as evidenced by the higher average posttest score of D3 Dental Engineering students (M = 72.86; SD = 10.752) compared to that of D3 Midwifery students (M = 63.75; SD = 12.143). Implementing an interactive E-module significantly influences English learning outcomes for first-semester students. This research emphasizes the necessity of interactive E-modules as an innovative approach to students in the context of the Fourth Industrial Revolution, highlighting the need for more effective learning methods. The implication of interactive e-module is digitally delivered learning materials designed to enhance engagement and interactivity.

I. Introduction

The globe is now experiencing a fourth industrial revolution, and this era is marked by the integration of advanced technologies such as artificial intelligence (AI), big data, and the Internet of Things (IoT) into the learning process. These technologies enable the creation of more personalized, adaptive, and interactive teaching methods, which provide learning experiences relevant to global needs and developments. English language teaching is no longer limited to traditional classrooms but has evolved into a rich digital experience where learners can access materials, exercises, and feedback instantly across multiple platforms [1].

Likewise, with its development, humans have become intelligent creatures who always improve their abilities to facilitate every activity [2]. All tools are tested to achieve the effectiveness and efficiency of every action taken to achieve high efficiency with minimal effort [3]. Technological progress is inevitable because it follows the progress of science [4]. Every innovation is designed to benefit a person's life. The use of technology can be done anywhere and anytime [5]; [6]; [7]; [8]. Humans have also enjoyed many benefits from the innovation and

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creativity created over the past decade [9]. Countries with high-tech capabilities (high-tech) are developed countries that cannot adapt to technological advances and are usually called failed states [1].

Moreover, interactive e-modules in English learning open up new opportunities for students to learn more effectively and relevantly, adapting to the demands of the Industry 4.0 era. By integrating digital technology, this approach presents an interesting and adaptive learning experience, allowing materials to be tailored to individual needs. In addition, interactive e-modules support the development of skills relevant to the modern world, such as communication, collaboration, and digital literacy. With an innovative and future-oriented design, these e-modules make it easier for students to access materials anytime and anywhere, making learning more flexible and in-depth. Improving the quality of learning in higher education must be in line with social developments, communication, and information technology [10].

Various alternative strategies and methods have been developed, including teaching materials. When a teacher develops teaching materials, pays attention to goals and students, and solves learning problems by adapting to the abilities that must be achieved. One way is to integrate teaching materials and technology to create English teaching materials that are easily accessible and meet these criteria [11]. One form of developed material is known as a digital-based module or E-module. According to the Association for Educational Communication and Technology (AECT), a module is defined as follows: (1) A learning module is a collection of learning experiences that are intended to achieve certain goals and are interrelated, usually consisting of several hours or weeks. If credit units are determined, then the module is called a small textbook [12]. Electronic modules are a development of digital printing modules, which are very different from printing modules and can be accessed via devices [13]. Using conventional teaching methods during the English learning process is not fun or creative and reduces motivation. This causes students to become bored. Students assume that textbooks/modules are only read and have difficulty if carried anywhere, although this is not interesting for students.

This research is also motivated by the fact that in the English language course, there has never been a creation of an electronic-based module or interactive learning e-module by the researcher himself as the lecturer in charge of the course. The COVID-19 pandemic became the basis for adapting or adjusting the interactive E-Module-based learning method. Preparing interactive E-modules for the course English for odd semester (I) students of the D3 Dental Engineering study program at Universitas Megarezky is an alternative learning method to ensure that the lecture process can be carried out optimally to confront the Fourth Industrial Revolution. The interactive learning e-module is founded on Flip Pdf Corporate Edition. Flip Pdf Corporate Edition is a PDF production solution available for online and offline use, encompassing text, audio, video, photos, and more. Electronic modules (e-modules) serve as interactive resources by using multimedia elements, including images, videos, and simulations, to convey information dynamically [14]This is done to motivate students, get them used to using technology, avoid monotonous teaching techniques, and improve students' digital competence.

Based on the explanation of the background of the problem, it can be concluded that English language learning has not been effective because (1) There is no module model based on interactive E-modules designed by lecturers teaching courses taught in class, especially English courses, (2) There is no interactive E-module design as a learning innovation. English during the COVID-19 transition period**.** To realize more effective learning, it is necessary to use interactive E-modules.

Some research results that are relevant discuss interactive electronic modules (E-modules) such as [8] stated that interactive e-modules were declared valid according to experts, very valid regarding material, teaching materials, and users, practical for users and students, and very interesting for students. [15] explained that e-modules can inspire critical thinking from basic knowledge, which CODA requires in the education and training of dental students. [16] stated that the results of the development of electronic modules produced online are flipbooks and can be disseminated through the exchange of s.id links and barcodes. The results of developing electronic modules for Javanese script or Moxa grew in the high category.

Previous research has emphasized the efficacy, practicality, and advantages of e-modules in promoting critical thinking and enhancing accessibility. The gap in this context pertains to the

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inadequately examined dimensions of optimizing and assessing interactive e-modules for English Language Teaching (ELT), especially with the requirements of the Fourth Industrial Revolution. This indicates that interactive electronic modules (E-Modules) help facilitate learning across diverse higher education courses, particularly in English. The researcher intends to perform a study entitled Interactive E-Modules: Revolutionizing English Learning for University Students in the IR 4.0 Era. To examine and evaluate the impact of interactive E-modules as an innovative approach to English language acquisition for D3 Dental Engineering students during the Industrial Revolution era. 4.0 This study examines the impact of interactive E-modules as an innovative approach to English language learning for D3 Dental Engineering students at Universitas Megarezky during the Industrial Revolution 4.0.

II. Method

This study uses an experimental method. Experimental research is considered the best evidence for the hypothesis of causality. This is because there is doubt about the equivalence of the groups before the experiment begins [17]. This suspicion of equivalence has led to this design being called a non-equivalent control design.

This research was conducted on odd semester (I) students of the D3 Dental Engineering study program at Universitas Megarezky. Students from the D3 Dental Engineering study program will be used as the subject of interactive e-module research. The study may seek to fulfil the distinct requirements of the Dental Engineering degree, necessitating students to cultivate both academic understanding and practical competencies. E-modules offer a versatile and interactive medium for integrating various components, particularly in fundamental sciences (e.g., anatomy, physiology) crucial for dental engineering. Expertise in dental prostheses, instruments, and equipment. Effectively developed e-modules can cultivate critical thinking and problem-solving abilities, essential in dental practice. The D3 Dental Engineering program prioritizes the cultivation of technically proficient professionals, highlighting experiential learning and the practical application of information in real-world contexts.

The variables in this study are the independent variable and the dependent variable. The independent variable consists of one variable, namely the Interactive English E-Module D3 Dental Engineering. The dependent variable studied is learning outcomes. In addition to the variables above, there are other variables that you need to control. These variables are (1) learning facilities and infrastructure and (2) the ability and seriousness of teachers in learning. Because these two variables are expected to be constant, they are expected not to affect the dependent variable of learning outcomes significantly.

The conceptual relationship between variables in this study is shown in the following figure:

Figure 1. *Conceptual Chart of Relationships Between Research Variables*

The population in this study was the first semester of the D3 Dental Engineering and D3 Midwifery study programs, with a total of 56 students. The research sample was determined using the saturated sampling technique. According to [18], the saturated sampling technique is a sampling technique that takes all members of the population as samples. D3 Dental Engineering students

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receive interactive electronic module-based learning, and the D3 Midwifery Study Program receives conventional learning therapy.

Designing interactive E-Modules using the following procedures: (1) Identifying general learning abilities or objectives, (2) Conducting learning analytics, (3) Identifying initial student behavior and characteristics. (4) Creating learning outcome indicators or specific learning objectives. (5) Creating reference test items. (6) Creating learning strategies. (7) Creating and/or selecting teaching materials. (8) Designing and implementing formative assessments or verification of learning materials, and (9) Revising e-modules.

The design of learning treatments, both for interactive and conventional E-Module-based learning models, is still general. The presentation of research instruments includes two main things, namely the type of instrument and the trial of the instrument. After the research data is collected, the activity carried out is to analyze the research data with certain data analysis techniques according to the type of research. The data collected in this study were processed statistically inferentially, statistical analysis using SPSS 26 for Windows computer software.

III. Results and Discussion

This section describes the findings obtained from the analysis of pre-test and post-test data. Both use the same test. The overview of the survey results is based on the results of descriptive analysis of the survey sample, with a total of 56 students consisting of 28 D3 dental engineering students and 28 D3 midwifery students.

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	N	Mean	Std. Deviation
Experiment Pretest	28	61.61	9,912
Posttest Experiment	28	72.86	10,752
Pretest Control	28	58.39	10,097
Posttest Control	28	63.75	12,143
Valid N (listwise)	28		

Table 1. Descriptive Statistics

Table 1 indicates that the average pretest score for D3 Dental Engineering class students was M = 61.61 (SD = 9.91), while the posttest score was M = 72.86 (SD = 10.75). In contrast, the pretest score for students in the D3 Midwifery class was M = 58.39 (SD = 10.09), with a posttest score of M = 63.75 (SD = 12.14).
A clearer description of the average student score based on learning strategies can be seen in graph 1.1 below.

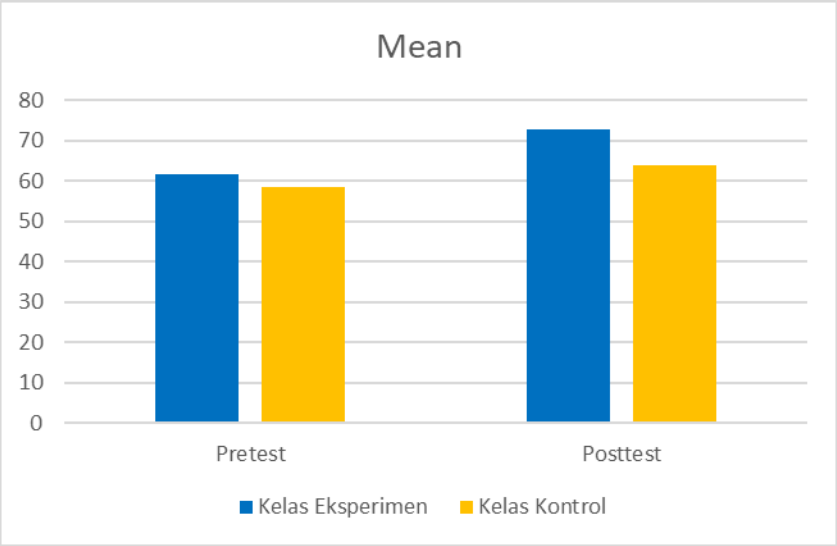

Figure 2. The average value of learning outcomes

	Class	Kolmogorov-Smirnova			Shapiro Wilk		
		Statistics	df	Sig.	Statistics	df	Sig.
Student Learning Outcomes	Pre-test Exp	,116	28	,200*	,973	28	,671
	Post-test Exp	,125	28	,200*	,952	28	,225
	Pre-test Con	,101	28	,200*	,974	28	,700
	Post-test Con	,157	28	,075	,939	28	,107

Table 2. Tests of Normality

Based on the Kolmogorov Smirnov normality test in Table 1.2, the significance value of the test before the experimental class is 0.671>0.05, the test after the experimental class is 0.225>0.05, the test before the control class is 0.700>0.05. The significance value of the test after the control class is 0.107>0.05. This proves that the data is normally distributed.
The notable enhancement noted in the experimental group indicates that interactive e-modules may be an effective instrument for augmenting learning, especially within English language instruction or other scholarly fields. E-modules can enhance student learning by providing a tailored and interactive educational experience.

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The learning outcome data of the students taught with the interactive electronic module-based learning model (D3 Dental Engineering) and the conventional learning model (D3 midwifery) were analyzed using the two independent sample t-tests statistical technique. This statistical analysis aims to determine the level of similarity between the two groups of students. The statistics of the pre-test t-test group are shown in Table 1.3 below:

		Levene Statistics	df1	df2	Sig.
Student Learning Outcomes	PreTest Ex	,776	3	108	,510
	PostTest Ex	,536	3	108	,658
	PreTest Kon	,536	3	103,488	,658
	PostTest Kon	,760	3	108	,519

Table 3. Homogeneity Test

From Table 3 above, the significance value of the test before the experimental class is 0.510>0.05, the test after the experimental class is 0.658>0.05, the test before the control class is 0.658>0.05, and the test after the control class is 0.519>0.05. 0.510>0.05. This proves that the data is classified as homogeneous data.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Learning outcomes	Experimental Class	,664	,419	2,971	54	,004	9,107	3,065	2,962	15,252
	Control Class			2,971	53,220	,004	9,107	3,065	2,960	15,254

Table 4. T-Test Results

Table 4 shows that the probability value of the t-test of the average equation is 2.97 with a significant value (0.004 < 0.05). The null hypothesis is accepted, which states that "there is a difference in the mean between the two groups". This means that the two classes have different knowledge of English.

The researchers tried to compare or match the results of this study with existing knowledge (theory and research results), and provide meaning or explanation for possible effects. The focus of the discussion is the influence of two independent variables studied, namely the learning model (based on interactive and conventional e-modules), on the dependent variable (student learning outcomes in English courses in the D3 Dental Engineering program). The results of the hypothesis testing are discussed based on the results of the SPSS version 26 analysis in the form of the main influence and the influence of other variables.

The hypothesis test results using SPSS version 26 show a difference in learning English between groups of students treated using interactive e-module-based learning models for D3 Dental Engineering students and conventional learning models for D3 Midwifery students at Universitas Megarezky. In theory, interactive and conventional e-module-based learning models can affect student learning outcomes. Many studies have investigated the effectiveness of interactive learning based on electronic modules. However, these studies show different results. Some argue that e-learning is not significantly different from conventional classrooms. However, other opinions argue

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that interactive learning based on electronic modules provides significant progress in the process and results of learning activities.

As previously explained, several theories and research results show the success of interactive e-module-based learning, including research conducted by [19] explained a significant increase in students before and after using interactive electronic modules on salt hydrolysis material. Meanwhile, Arosyad et al. (2021) showed that using English electronic modules designed to improve student learning outcomes had a significant effect. Then, the results of this study are supported by the results of research from [15] E-modules can inspire critical thinking and basic knowledge, which CODA needs in the education and training of dental students. Furthermore, [20] concluded that e-modules were designed to answer problems related to the presentation of e-learning teaching materials in higher education. E-modules are part of the characteristics of e-learning, and students are interested in learning the material through e-modules. From several research results, it is stated that the learning model using interactive E-Modules has a significant effect on student learning outcomes. So, the results of this study are different from the results of other studies, which state that in English courses, interactive e-module-based modules have never been created by the researcher himself as the lecturer in charge of the course.

The findings of this study E-module-based learning allows for collaborative and student-centered learning so that the independent learning process is more likely to occur in students and is proactive. Learning activities focusing on students include problem-solving, collaborative work, investigative work, or experiments. Interactive e-module-based learning allows learners to learn anytime and anywhere without being limited by space and time [2]. Learners can access materials and do assignments according to their learning style, time, place, and wishes. However, in the context of this study, everything must be controlled, including time and place, so there is no bias in the research results. One factor causing the absence of this difference may be limited time and space.

Interactive e-modules can tackle prevalent issues in English learning by utilizing digital technologies and tactics that accommodate varied learning requirements, enhance engagement, and offer personalized assistance. Illustration Integrating gamified components, including quizzes with instant feedback, achievement badges, and leaderboards, enhances the enjoyment of learning and encourages active student participation. E-modules equipped with integrated speech recognition enable students to refine their pronunciation and obtain immediate feedback. For example, learners may record their pronunciation of a word and juxtapose it with that of a native speaker.

The study's limitations offer helpful insights that must be recognized to contextualize its findings and guide future research. Notably, the sample size is rather small (56 students), which constrains the generalizability of the results to a broader population. Subsequent research may encompass a larger and more heterogeneous sample to corroborate these findings. The research concentrated on two particular programs, D3 Dental Engineering and D3 Midwifery, which may not accurately reflect the efficacy of interactive E-modules in other fields or educational tiers. The study fails to indicate the intervention's length, which may affect the outcomes. A longitudinal study could yield more profound insights into the enduring effects of interactive E-modules on educational achievements.

It is then shown that the hybrid learning process, which combines traditional face-to-face education with integrative technology, produces outcomes similar to or better than the conventional learning process. Therefore, combining interactive e-modules as additional resources can help meet students' needs for direct interaction, resulting in different student learning processes and outcomes, as evidenced by the t-test results in Table 4. Thus, there is a difference in results English learning between groups of students who were given treatment using an interactive e-module-based learning model for D3 Dental Engineering students and using a conventional learning model for D3 Midwifery students as one of the innovations in English learning models in the era of the 4.0 revolution which students at Universitas Megarezky explicitly implemented.

IV. Conclusion

The outcomes of English learning are significantly influenced by the comparison between groups of D3 Dental Engineering students utilizing an interactive e-module-based learning

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model and D3 Midwifery students employing a conventional learning model. This innovation in the English learning model at Universitas Megarezky aims to enhance the learning process, particularly in English, to achieve effective and efficient outcomes during the COVID-19 pandemic and to support the Industrial Revolution 4.0 era. Interactive e-module-based learning enables learners to acquire knowledge at any time and from any location, unrestricted by spatial or temporal constraints. Students can access resources and complete tasks based on their preferred learning style, schedule, and location. Interactive e-modules can address common challenges in English learning by employing digital technologies and strategies that cater to diverse learning needs, increase engagement, and provide individualized support. Depiction The incorporation of gamified elements, such as quizzes with immediate feedback, accomplishment badges, and leaderboards, augments the pleasure of learning and promotes active student engagement.

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