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Research Article

Using of sigil software in math education: e-module development and effects on self-regulated learning skills

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Abstract

In the delivery of content, it is important to have multimedia elements so that the learning material delivery can be well received by students. One of these elements is the e-module. This study aims to create an e-module based on Sigil software on enumeration principles, as well as to examine the effects on self-regulated learning (SRL) using the e-module. In this study, action research techniques were used. Some of the researchers are both practitioners and researchers in the research. This e-module development focuses on the development design phases of Alessi & Trollip (2001), which consist of three stages, namely: the planning stage, the design stage, and the development stage. Product tests were performed at the production stage to assess the feasibility of the e-module. The validation test performed was an alpha test and a beta test. The alpha test was carried out by seven content experts and two media experts. The beta test was carried out through a beta-1 test involving 30 students and a beta-2 test involving 27 students of Vocational High School, Lembang, Indonesia for the 2020/2021 academic year. Data were collected through interview guidelines, questionnaires for material experts and media experts, students who responded to questionnaires, and questions' tests. Data analysis techniques for assessing the viability of e-modules used descriptive data analysis, Cochran Q Test for three or more paired samples As a result of the study, an increase has been observed in students' ability to design e-modules for mathematics lessons. At the same time, it supported the development of student's cognitive and affective factors related to the mathematics course. It has been determined that e-module design is a very effective instructional design in the development of students' self-regulated learning skills. In future research, the effects of e-module design stages on students can be examined in detail. In addition, it can be examined in detail which self-regulated learning skills are developed and to what extent.

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Introduction

Under the circumstances of the Covid-19 pandemic that most countries in the world, are facing the necessity of the governments that are forced to transform schooling practices from face-to-face communication to home online-learning based. Since the transformation from schools' face-to-face learning to home online-learning environment is essential, therefore new challenges arise, i.e. the willingness of students and teachers in the implementation of changes. So far, students are accustomed to face-to-face learning with direct instructions and text-taught materials.

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New independence still needs to be established. There are also few online learning materials that students can access. Research results of (Aljassar & Altammar, 2020) express the difficulty of teachers and students, in government schools of Kuwait, in synthesizing and retaining textbook knowledge when it is not supported by online learning materials. Research findings from (Supianti & Yaniawati, 2017) shows that pupils: do not have the initiative to learn by themselves, they wait for instructions or assignments from the teacher in learning; they are not used to diagnosing learning needs, students learn the material provided by the teacher, not what they need; students' learning goals/targets are still limited to obtaining satisfactory grades, not the abilities they should have developed; they are unable to monitor, regulate, and control learning, and seemingly to learn what is needed for the moment; there are still students who give up when they are faced with difficulties, and some even avoid it; and students rarely evaluate the learning process and results.

Self-regulated Learning & Technology Using in Math Education

Self-regulated learning (SRL) is essential for students since SRL is a determining factor in SRL (Wahyuni, 2010); (Cheng, 2011); (Murray, 2013); (Sundayana, 2018); (Bungsu, 2020). Zimmerman (1990) suggests that SRL is a mechanism that takes place due to the influence of goal-oriented thoughts, feelings, strategies, and behaviors.

Woolfolk points out that knowledge, motivation, and self-discipline are the factors that influence SRL. Woolfolk points out that the factors that influence SRL are a few knowledge, motivation, and self-discipline (Alhaddad, 2014). The freedom of learning emphasizes the value of personal accountability for learning practices. In the learning process, students with SRL can build learning goals, try to monitor, regulate, and control cognition, motivation, and behavior, to control predetermined goals.

In today's mathematics learning, the development of technology-based mathematics teaching materials that are innovative, creative, effective, efficient, and contextual, following the conditions, needs, skills, features, and socio-cultural fields, demanded schools and students. Initiative and enthusiasm for educating students using mobile learning are higher, and mobile learning is more appropriate for students who are afar and having ethnic differences (Chandran, 2010).

Mobile learning is described as the ability of mobile devices to learn anywhere and at any time (Johnson & Williams, 2020). The presence of e-modules is very useful for the consistency of the learning process, which cannot be achieved in face-to-face learning as it is today. One aspect of pedagogical competence is the capacity of teachers to develop and use media and learning resources (Peraturan, 2005). According to Dawley (Albalawi, 2017), a new pedagogy is required to effectively incorporate cellular learning into the learning environment. Sincuba & John (2017) argues that to generate positive attitudes among students towards mathematics, educators and researchers, consideration should be given to exploring alternative teaching and learning methods so that students can improve conceptual awareness and understanding and positive attitudes towards mathematics. Mobile Learning Technology-Based Instruction is a technologically advanced approach in this context (Sincuba & John, 2017).

Present conditions and technological advancements have enabled teachers to create e-modules. According to (Yaniawati et.al, 2019) and (Hammad et.al, 2020), mathematics is a science that underlies the growth of modern technology in Indonesia and Kuwait. Increasing technical advancements in all life factors have opened up opportunities to meet the needs for information technology facilities that will develop student mathematical skills (Yaniawati et.al, 2020). In partnership with We Are Social, Hootsuite releases the development of internet users around the world, including Indonesia. In Indonesia, with a total population of 272.1 million, the Internet users reached 175.4 million in 2020, a rise of 17 percent from 2019. Meanwhile, the number of smartphones connected reached 338.2 million units, almost twice the number of Internet users. This means that many Indonesians have more than one smartphone at hand. It is hoped, therefore, that the e-module would be used by students. The application of ICT in mathematics at the secondary school level in West Java shows 99 % of mathematics teachers at secondary schools in West Java have used ICT in mathematics. The ICT forms, which are mostly performed by instructors, use interactive CD media, animations, and power points, as well as assigning students to search for content from the Internet. Meanwhile, online learning is the least type of ICT in use. Half of the teachers researched social media and used math tools. Other types of ICT that have been carried out include learning with android apps, statistical materials with Microsoft Excel, computer-based tests, and the use of blogs as learning media (Supianti & Yaniawati, 2017). Moreover, in Kuwait, the year 2020 encompassed a population of approximately 5 million people. Almost 90% of this population are internet users. The total number of students and teachers in schools and universities has reached 973,000. A majority of these students and teachers are utilizing advanced technology tools and e-learning platforms to progress in their learning at home during the pandemic.

Most junior high schools in Bandung, Indonesia, already have computer laboratories and internet connectivity; some schools also have their e-learning sites and local WiFi access (edubox) so students do not need a quota to access e-learning teaching materials. Teachers' and students' skills in the use of technology are also good (Supianti & Yaniawati, 2017). In one of our neighboring countries, Malaysia 80.14 % of the population are Internet users, which ranks third in the world after China in terms of e-learning growth rates at a growth rate of 41%. The implementation of e-learning in many Malaysian universities, such as the Faculty of Education of Universiti Sains Malaysia (USM), in the learning phase, has been effective, and the e-learning facilities used in these institutions are good and adequate. Most lecturers use a range of mathematical applications such as Geogebra, Cabry, Maple, and other learning software.

Based on the data mentioned above, this study conducted research and development of e-modules assessed by Sigil software to improve SRL. Febro, et al, 2020) reported that utilizing the e-learning module in the development of skills among participants was significant. Apsari, (2018) notes that research and development is a method or measure to produce a new product or to enhance an existing product that can be justified. Mathematics research and development needs to be undertaken as an enhancement to make it easier for students to understand mathematics. With ICT, students can control their learning progress without interference from others, can also browse learning materials as often as they need, and can repeat exercises to understand the content (Lin et al, 2017).

Problem of Study

The main problem of the study is;

- Does e-module design affect students' self-regulation skills in mathematics teaching?

The sub-problems of the research are as follows:

- What actions should be taken for students to master e-module design with Sigil software?;
- What kind of pedagogical path should students follow in which stages in e-module design with Sigil software?
- How is the quality of students' e-module designs in terms of expert evaluation?

Method

Research Model

This study uses a research and development (R & D) model of Alessi & Trollip (2001), which consists of three stages, namely: the planning stage, the design stage, and the development stage. Product tests were performed at the production stage to assess the feasibility of the e-module. R & D is a research method used to produce a particular product, and test the effectiveness of the product. It is the process or steps to develop new products or improve existing products (Sugiyono, 2016).

Participants

The beta test activity was carried out in two stages consisting of beta test 1 to 30 students of class XII and beta test 2 was carried out to 27 students of class XI poultry.

Table 1.

Structures of Participants

		Beta Test 1		Beta Test 2	
		F	%	F	%
Gender	Female	24	80	22	81
	Male	6	20	5	19
Grade		XII		XI	

Lembang State Animal Husbandry Vocational School was established on October 13, 1980, with National School Principal Number (NPSN) 20267759, School Statistics Number (NSS) 322022301304. Lembang Animal Husbandry Vocational School achieved accreditation A with Expert Competencies owned are Ruminant Livestock Agribusiness, Poultry Livestock Agribusiness, and Veterinary Nursing. Information can be accessed at www.snakma.com and email admin@snakma.com.

Figure 1.
School Building

Figure 2.
Computer Laboratory

Data Collection Tools

Data were collected through the following instruments: validation sheet of teaching materials, used to measure the quality of teaching materials (e-module sigil); Questionnaire, used to measure learning independence; interviews, used to measure self-regulated learning and strengthen the data in the questionnaire.

Self-regulated Learning Scale

Self-regulated Learning Scale to developed by teachers and validated by some experts. The development of this instrument went through two times expert reviews and two trials. The instrument was carried out by nine experts involving seven material expert validators and two media expert validators. The material questionnaire consisted of 20 question items about the content of mathematic and 27 questionnaires about media of information technology. The review results from seven material experts gave an assessment of 4.19 and input in terms of editorial/language revisions. Meanwhile, the results of a review from two media experts assessed 3.97, and input in terms of animation should be opened directly from the application. Furthermore, the instrument was tested in the first stage on 30 students and resulted in the reliability of Cronbach Alpha r = 0.646 then the second stage was tested on 27 students and resulted in r = 0.684.

Semi structural Interview Form

Interview forms were conducted with nine questions to six students (three superior and three low), who used e-modules assisted by sigil software. One of the questions is: Have you studied mathematics using e-modules, did it make you understand and understand more about the material of counting rules?

T: Have you studied mathematics using e-modules, did it make you understand and understand more about the material of counting rules?

S: The e-module helped me in understanding the material on the rules of enumeration and it was more interesting because there was a video

Student response questionnaires, and interview sheets. Quantitative data were obtained from questionnaires and qualitative data were obtained from answers or recommendations from content experts, media experts, and students, as well as from interviews.

Data Analysis

Data analysis techniques for assessing the viability of e-modules used descriptive data analysis, Cochran Q Test for three or more paired samples (Riyadi et al. 2017).

Procedure

The development model uses the steps of Alessi and Trollip (2001). It is very suitable for developing digital modules (e-modules) since this development model describes multimedia components such as text, pictures, animation, and video. The production phase of Alessi and Trollip consists of three stages in product development, namely planning, design, and development. The development stage scheme can be seen in the following Figure 3:

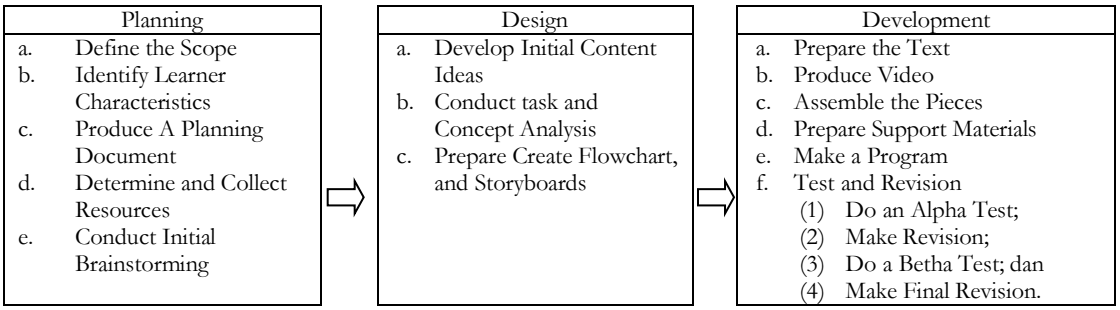

Figure 3.

The Steps for Alessi and Trollip's development model (2001)

At the **planning** stage, the activities carried out are (1) determining the objectives and material, namely the rules of enumeration; (2) identify the characteristics of e-module users, namely mathematics teachers and students of Vocational High School, Lembang, Indonesia; (3) make the initial product design; (4) collect relevant data or sources in making the e-module; and (5) gathering ideas in product development, by holding a Focus Group Discussion. At the **design** stage, the authors carried out the following activities: (1) designing the initial content of the e-module display assisted by Sigil software; (2) analyzing assignments and concepts, namely determining the order of the material and organizing the material so that it is easy for students to understand; (3) create flowcharts and storyboards. At the **development** stage, the following activities will be carried out: (1) preparing the text of the enumeration rules; (2) prepare learning videos related to enumeration principles; (3) combining text, images, and videos; (4) preparing other supporting materials; (6) create an e-module following the designed storyboard and supported by prepared text, images, and videos; and (7) testing and revising the e-module.

Thus, when tested and revised, a product is of high quality. The evaluation phases of the product are the alpha test and beta test. The alpha test (validation) is done by seven content experts and two media experts. The validity test is structured to provide relevant, meaningful, reliable, and useful information in concluding the researchers (Effendi, Zulkardi, Putri, & Yaniawati, 2018). The e-module product has been updated based on input from content experts and media experts (Moore, 2012). If the analysis findings have been accepted by the content expert and by the media expert, a beta test will be carried out. The beta test is split into two phases: beta-1 and beta-2. The beta-1 test consists of up to 30 students who have already been given enumeration materials, while the beta-2 test consists of 27 students of Vocational High School, Lembang, Indonesia. The purpose of the beta-2 test was to determine the student's response to the e-modules assisted by Sigil software on the material used in the listing rules. In addition, the student response questionnaire findings have been collected and analyzed.

Results

Using Sigil Software

Figure 4 shows the initial Sigil software that is an open-source editor software for epub. Epub (electronic publication) is a digital format, which is a standardized format introduced by the International Digital Publishing Forum (IDPF) in 2011. The open eBook replacement program that acts as an open book format is epub which can be accessed from HTML, XHTML, XML, CSS files that act as a single file with an epub extension. The epub format is today's most common digital book format. This is because different features can be used to alter the appearance of an ebook on the epub such as the availability of commands used to insert video and audio files, in addition to images and text, to further improve the presentation of the book. In addition, epub is also friendly and supports many devices, such as Android computers (using Ideal reader, FBReader0, iOS (ireader), computers (accessed on Google Chrome, Firefox plugins), Blackberry Playbook, SonyReader, and various other devices (Maharani et al. 2015).

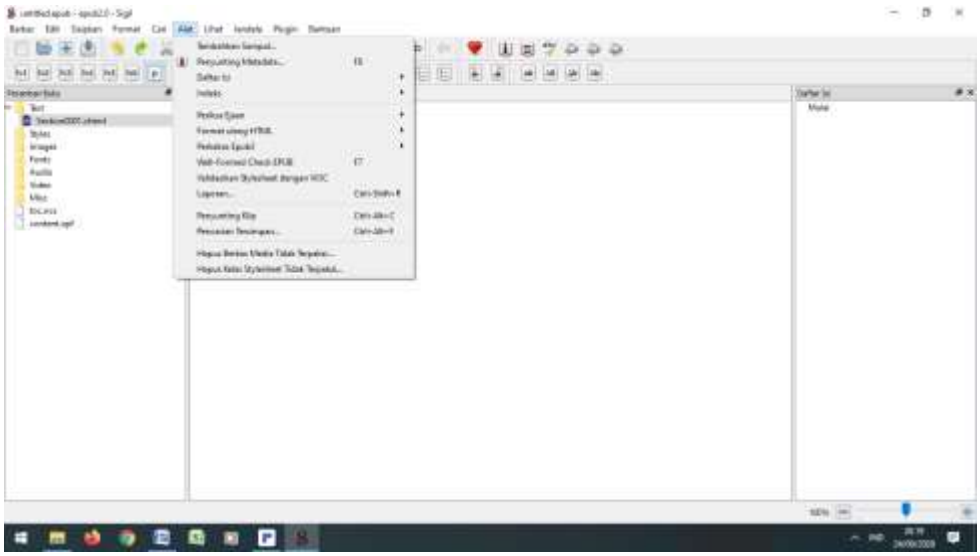

Figure 4.
Initial Display of Sigil software

The material that has been described and stored in a doc format can be extended using epub. To run and develop the epub, first compile the teaching material into a word. Then save the material that was created with the HTML extension, by selecting File>Save as>Web Page, filtered. However, before that, the editing was carried out in such a way that the material produced did not change when it was converted to Sigil using epub. After editing the material to be rendered in the next word, enter the Sigil HTML tab. The first step that needs to be done is to open the HTML file that has been rendered to Sigil using File>Open, then select the HTML file.

Counting rules are the rules used to calculate all the possibilities that may occur in a case. There are a variety of techniques for counting rules, such as counting techniques, factorial notation, permutation, and combination. The difference between permutations and combinations in the solution of verbal problems is that verbal problems are solved by permutation if the order of the elements is reversed with different values or if the elements in the problem have a status. In the meantime, verbal questions are resolved in combination if the order of the reversed elements is the same or if the element in question has no status.

The SRL is a combination of academic skills and self-control that makes learning easier, making students more motivated. Independence emphasizes student learning experiences that are full of accountability for student progress in learning. The attitude of freedom can be seen by the ability to overcome behavioral problems. With behavioral improvement, students often have an increase in thought, assuming that learning must be independent without relying on the help of others. SRL is a recursive (repetitive) cognitive activity cycle that involves practices to evaluate tasks, choose, adopt or define strategic approaches to achieving the objectives of the task, and track the outcomes and strategies that have been implemented. SRL is not individual learning, but learning that involves a student's independence from learning (Astuti, 2016).

Bartholomew (Mulyono et al, 2018) specified that SRL is the ability of students to assess themselves and ask questions so that they know. Learning for independence blends an understanding of what is also not understood with an understanding of learning to gain knowledge. The most important student attitude is SRL in mathematics. Independence in studying mathematics does not mean that students learn to distinguish themselves from other students. As Mu'tadin reported in (Hasibuan et al, 2018), an independent study is not an effort to alienate students from study partners. Students can ask questions, discuss or ask for explanations from others. SRL will be generated from the SRL process. The key feature of SRL is that the growth of students' learning skills does not rely on factors such as instructors, peers, classes, and others. Haris Mudjiman (Astuti, 2016) argued that the implementation of an independent learning process is one solution to the issue of quality education. SRL is an active learning practice that is motivated by a desire to master a skill and is based on the experience or skills that you already have. SRL offers opportunities for students to digest more learning materials with less material from the teacher.

Development of e-modules Assisted by Sigil Software

Based on the researcher's study, it is understood that the Vocational High School, Lembang, Indonesia, still uses textbooks and PDF modules that students will feel bored with learning. The unavailability of IT-based learning media makes learning dull and monotonous. It is therefore important to create updated digital teaching materials to make them more appealing by integrating videos in the form of e-modules assisted by Sigil software to make the

learning process more engaging and to enhance student's critical thinking and SRL skills. This is in line with the view (Aljassar & Altammar, 2020) regarding the problem of SRL, media that can increase SRL in the millennial era is computer and internet-based media, which is often called digital media.

Development of e-modules assisted by Sigil software on enumeration rules material carried out using the Alessi and Trollip model phases, i. e. planning, design, development (Peraturan, 2005). The final product to be produced is an e-module with an epub file. This development model starts at the planning stage. According to (Sari, 2016), the planning process involves tasks such as student needs analysis, curriculum analysis (KI-KD), designing and developing media, preparing questions and answers, determining the suitability of materials for curriculum needs, and collecting e-module fonts, images, and videos.

After the planning has been completed, the next step is the design stage. The product being developed is an e-module with the assist of Sigil software for enumeration rules, which are adapted based on basic competencies. At this stage, the preparation of e-module products is carried out with the aid of Sigil software and validation tools. The process for the development of the e-module assisted by Sigil software consists of opening, content, and closing. The opening part is covered by the e-module teaching materials. The content section consists of a table of contents, concept maps, basic skills, learning goals, history, contextual problems, material, summary, practical questions, post-test. And there is a reference in the closing section.

The next stage is development. This is the stage of making an e-module assisted by Sigil software and the alpha test stage. According to Elyas and Yudianto, in (Murray, 2013) short steps to make the Sigil application are: (1) install the Sigil application, (2) prepare files that will be used as digital books, (3) run the Sigil application, (4) save work results in the form of an epub, (5) opening files with a reader application.

The finished product is subjected to an alpha test by educational experts and practitioners consisting of lecturers and teachers. In the meantime, media experts are made up of digital simulation teachers and productive teachers. Validation aims to obtain feedback, suggestions, and criticism to enhance the e-module assisted by the Sigil software being developed. After the validation has been completed, the teaching material is then revised by expert feedback on the validation questionnaire. From the results of the evaluation of content experts and media experts, the e-module assisted by Sigil software was given a decent category. As a result, the researchers concluded that the e-module assisted by the Sigil software on the developed material of the enumeration rules met the valid criteria so that the e-module could be tested.

After the product has been declared feasible by the experts, the next step is a blind test. Based on the results of the beta-1 test, the e-module assisted by Sigil software has obtained a feasible category, so that the e-module product assisted by Sigil software on the enumeration rules material has been declared suitable for use following the expert review. In the second beta test, two forms of data collection were carried out, namely the collection of students' response questionnaires for e-module items assisted by Sigil software on enumeration rules material and data collection of test results. Based on the results of the student response questionnaire, it was concluded that the e-module assisted by Sigil software could be used. In the meantime, based on the size of the effect, it can be concluded that the use of the e-module assisted by Sigil software is effective in improving students' critical thinking skills.

Based on previous research by several researchers, such as (Alperi, 2015) and (Wirasasmita & Uska, 2017), the novelty of this study lies in the development of e-module teaching materials assisted by Sigil software on enumeration rules. Previously some used Sigil software teaching materials but in other materials. No one has yet developed the material for the enumeration rules. Then some have developed teaching materials on the principles of enumeration, but they are still in pdf format.

According to (Alperi, 2015) Sigil's digital books have advantages compared to other digital books, including being able to contain video content, images, and sound/ songs so that learning becomes more interesting and students become more active. The advantages of the product in the development of Sigil-assisted e-module teaching materials are: (a) Sigil-assisted e-module teaching materials are easy to apply because they can be opened on smartphones and laptops/ PCs, (b) Sigil-assisted e-module teaching materials software can be accessed offline so that it will not be a problem for students in using e-module assisted by Sigil software when running out of internet data packages, (c) e-module teaching materials assisted by Sigil software are easy to understand and operate, (d) e-module teaching materials assisted by Sigil software can insert a video that can be opened so that students do not feel bored in learning the material.

Amalia and Kustijono (2017) that the product weaknesses are: (a) the e-module product assisted with Sigil software requires an epub reader application so it must first download the epub reader application, (b) the e-module product assisted with Sigil software developed in this study is only limited to material enumeration rules, (c) the Sigil-assisted e-module product cannot be directly inserted with animation. The animation form must be converted into an MP4 format, (d) e-module products assisted by Sigil software cannot be directly inserted into the mathematical formula text in the form of Microsoft Equation. Text in the Microsoft equation must first be converted into JPG form.

In Clark and Mayer (Yogiyatno & Sofyan, 2013), it is argued that the best research approach to assess the efficacy of learning is to compare the test performance of students learning with the learning characteristic studied with the test performance of students learning without the learning characteristics studied. One of the teaching materials that help develop psychomotor skills is e-modules (Wulandari, 2013).

This research and development led to the creation of an e-module product with the aid of Sigil software, enumeration rules. The e-module was shown to be feasible by experts and field trials were conducted to assess its efficacy in the opinion of the students. E-module assisted by Sigil enumeration rules meets the development phases of Alessi & Trollip, including the planning, design, and development phases. The following shows a variety of e-module displays assisted by the Sigil program on the enumeration rules.

Figure 5.
Cover View

Figure 6.
Material Display

Figure 5, is shown the front cover page of the e-module product with the help of the Sigil software in the enumeration rules material is the title page and user identification. The cover page "Mathematics Learning Module Enumeration Rules for SMK/ MAK students", shows an example of the inclusion of certain dice that are frequently used in the Learning Enumeration Rules to draw students' attention.

In Figure 6, the image content on the material is developed in the form of a jpg file to produce an accurate image form. The use of color in the quality of the picture is clear and easy to read. Text and photos are displayed close together on a single page. The picture presentation is intended to provide an example of the material presented.

Figure 7.
Display Material Contains Video

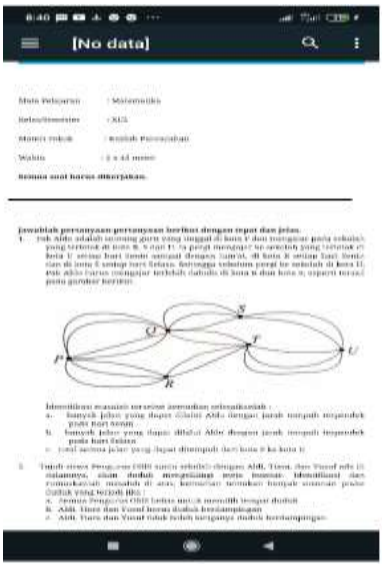

Figure 8.
Evaluation Material Display

Figure 7, is shown an e-module assisted by Sigil software on the enumeration of rules of the material equipped with a video explaining the material and discussing the questions. The video content presented here is a description in the form of a short animation of the subject. The next video includes lessons on the sub-chapters found in the e-module assisted by Sigil software, namely counting, permutation, and combination techniques. Thus, every video can be played at the end of each segment of the content. The resulting video is fitted with a button for play, pause, stop, volume, and full-screen. Students can easily pause, play the video as they wish on video supported by the Sigil software MP4 which is obtained from YouTube.

In Figure 8, the evaluation material on the e-module assisted by Sigil software on enumeration rules material is presented in the form of multiple-choice questions and description questions. At the end of each section, ten evaluation questions are given, consisting of three evaluation materials. For the final evaluation (posttest), six items are presented in the description.

Evaluation of e-Module Desing by Experts

The product validation test based on the Alessi and Trollip (2001) development model was carried out in two stages of activity, namely the alpha test and the beta test. The alpha test was carried out by seven material experts and two media experts, and the beta test consisted of two stages, namely the beta-1 test carried out by 30 class XII students and the beta-2 test was carried out by 27 class XI students of SMKN Livestock Lembang. The next step was to carry out the validation test phase by two content experts and media experts to assess the feasibility of the product and make revisions if there are suggestions from the two experts. After the e-module with Sigil software was finished, the experts reviewed the quality of the e-module with Sigil software. There is a comment column in the feasibility questionnaire filled out by the experts to get suggestions for a review process of the e-module with Sigil software on enumeration rules material.

Based on the results of the evaluation by seven material experts on the four aspects, an average score of 4.19 was achieved, which was qualitatively categorized as Feasible ($3.4 < x < 4.2$). Results of the examination by seven material experts on the four dimensions of the material validity assessment are summarized in Table 1 below.

Table 1.
Result of Material Expert Assessment

Aspect	Material Expert							Average Score	Category
	I	II	III	IV	V	VI	VII		
Theory	4.44	4.11	4.33	4.33	4.22	4.56	4.78	4.40	Very worth it
Question	4.83	4.33	4.00	4.00	4.33	4.17	4.00	4.24	Very worth it
Language	4.00	4.00	4.00	4.00	4.50	4.00	4.00	4.07	Well worth it
Implementation	4.00	4.00	4.00	4.00	4.00	4.33	4.00	4.04	Well worth it
Average Total Score								4.19	Well worth it
Category								Well worth it	

Results of the two media experts' evaluation of these three factors showed an average overall score of 3.97, qualitatively classified as eligible (3.4 < x < 4.2). Therefore it can be assumed that the e-module product assisted by the Sigil program on the enumeration rules material, is appropriate for use in compliance with the proposed revisions. Findings of the evaluation of the three dimensions of validation by two media experts are summarized in Table 2.

Table 2.
Result of the Media Expert's Assessment

Aspect	Media Expert		Average Score	Category
	I	II		
Display	4,40	3,93	4,17	Well worth it
Use	4,33	3,67	4,00	Well worth it
Utilization	3,50	4,00	3,75	Well worth it
Average Total Score			3,97	Well worth it
Category			Well worth it	

Results from the beta-1 test assessment carried out by 30 students on the three aspects concluded that the e-module assisted by Sigil software on enumeration rules material is suitable for use for the beta-2 test following the suggestions and input. The average overall score in this beta 1 test was 3.77 which was qualitatively categorized as "feasible" (3,4 < x < 4,2). The following Table 3 presents the beta-1 test of the three aspects of the assessment.

Table 3.
Result of Beta-1 Test Assessment

Aspect	Average Score
Software	3,73
Learning Design	3,74
Visual Communication	3,85
Average total score	3,77
Category	Well worth it

Results of the beta-2 test assessment which consisted of three aspects overall can be concluded that the e-module assisted by Sigil software on the enumeration rules material showed an overall average score of 3.57. Qualitatively, it is included in the feasible category (3,4 < x <4,2). The following Table 4 presents the results of the assessment of the three aspects by the beta-2 test.

Table 4.
Result of Beta-2 Test Assessment

Aspect	Average Score
Software	3,54
Learning Design	3,46
Visual Communication	3,72
Average total score	3,57
Category	Well worth it

Effect Size of the e-Module Assisted by Sigil Software

An effectiveness test was carried out by giving pretest and posttest to determine the level of effectiveness of the e-modules assisted by Sigil software product that was developed to analyze students' mathematical critical thinking skills, namely by looking at the difference in scores before and after using the e-module assisted by Sigil software. The pretest and posttest activities are carried out after the beta-2 test. Calculation of results of the effectiveness test was carried out using the effect size.

The test instrument was carried out on all students of the Vocational High School, Lembang, Indonesia. Complete data from the pretest and posttest results can be seen in Table 5. From the post-test results data, more than 80% of students have reached the minimum mastery criteria. Mathematics learning using e-module assisted by Sigil software by giving 6 essay questions. The questions have gone through the material expert validation process. The number of questions was based on considerations of the supervisor, material experts, and teachers of the

Vocational High School, Lembang, Indonesia. Based on results of data analysis calculated using the effect size formula. Results of the overall effect size assessment can be seen in Table 5.

Table 5.
Result of Effect Size Assessment

Group	Pretest Mean	Posttest Mean	Posttest Standard Deviation	Effect Size	Criteria
Experimental Group	21,98	75,68	12,28	4,37	High

Based on Table 5, the value of the effect size is 4.37, including the high criteria. This illustrates that the use of e-modules assisted by Sigil software on enumeration rules material has a very significant effect on the mathematics learning process. In addition, the use of e-modules assisted by Sigil software is more effective and can improve students' critical thinking skills. The pretest and posttest questions used consisted of six items representing six-question indicators.

Effects on Student Regulated Learning (SRL) Skills

The SRL data was collected from a questionnaire using the Likert scale. The questionnaire consisted of 30 statements, of which 15 were positive questions and 15 negative questions, and were answered by 27 students of the Vocational High School, Lembang, Indonesia. After completion, the data from the results of the questionnaire were collected and the data were analyzed to understand the student's learning independence through the use of the e-module assisted by Sigil software on the enumeration rules material. Based on the results, the total average student response rate was 40.79 %. This means that almost half of the students are independent in learning mathematics.

Discussion

The development of the e-module with Sigil software helps to generate digital reading rules that are packaged with the Sigil software, as the e-module has text, imaging, and video content. In addition, the e-modules assisted by Sigil software product contains components including cover page, table of contents, concept charts, basic skills, learning objectives, history, contextual problems, documents, summaries, questionnaires, blogs, debate, and a website reference, Filtered (*HTM; *HTML, etc.) that is then saved in the form of a web page.

Furthermore, all content becomes one file in the form of text, images, and videos to become an epub file. This epub file can be opened on a laptop/ PC by using the help of the Readium application on Google Chrome. To open an epub file on a smartphone, a person uses an epub reader application or Readily which can be downloaded via Google Playstore on a smartphone. As Al Fakih stated (Al Fakih, Morei, & Salehi M, 2020) that learning via cellphone has become one of the most popular learning tools used by the younger generation, which is the result of using these devices in education. The use of e-modules assisted by Sigil software on enumeration rules material is feasible and has a significant effect on the mathematics learning process.

The SRL of students using e-modules assisted by Sigil software is successful in improving SRL, as can be seen from the attitudes of students who demonstrate self-confidence in the learning process. Yamada et al., (2017) said that SRL is an important educational theory and concept in education, globally. Students learn on their own whether or not they have teachers. As result students are encouraged to pursue exercises to read and review materials from a range of outlets before and after learning activities, such as textbooks, e-modules, and the Internet.

As a result, many emerging technologies can provide more knowledge upon entering the technological age. Technology is evolving as time continues to develop (Pratama, Ulfa, & Kuswandi, 2018). Concerning technology that is increasingly sophisticated and easy to access at affordable prices, modules that are usually presented in printed form using electronic technology using computer modules can now be presented in digital form and called e-modules.

The development of the media is currently undergoing a transition in the time from the initial use of print media to digital media. This has an impact on the world of education, particularly in the presentation of learning media. The presentation of learning media allowed the use of interactive media, not restricted only to print media. An example of this presentation is an e-book. An e-book or e-book is an electronic edition of a printed book that involves an electronic computer and special software for opening the book.

The existence of innovation in the development of teaching materials in learning is driven by the development of e-book technology. According to (Kassabolat et al., 2020), that the use of teaching materials prepared following the principles of learning technology, is important for individuals to design an effective and interactive learning environment. Therefore, the teaching materials can be transformed into electronic presentations, one of which is e-

modules. Electronic modules can be defined as learning tools designed electronically, containing interesting and systematic material to achieve an expected competency (Awaluddin & Wanarti, 2016).

Thus, technology will help increase students' confidence in learning. This is in line with Attwell's study (Albalawi, 2017) that, cellular learning helps students build self-esteem and self-confidence with technology. In the research result of Wong and Wong (2019) that technology can increase students' interest in learning and related to mathematics performance. The electronic module adapts the characteristics, format, and parts of the print module in general. The objectives of the e-module are as follows: (1) students can learn independently with or without teacher guidance; (2) the teacher's role is not too dominant in learning activities, (3) accommodating various levels and speeds of student learning, (4) students can measure their level of mastery of the material that has been studied. Based on the above conclusion, it can be defined that the e-module is a learning medium whose effectiveness would be the same as face-to-face learning. The e-module may be said to be a tutorial activity on the part of a writer that is delivered in writing, and thus e-module should be written as a teaching subject or something that communicates learning and put forward in the module that has been written.

Conclusion

Based on the results of the development and discussion of e-module development assisted by sigil software, the authors can draw the following conclusions: E-modules are effective in generating student learning independence, as can be seen from the attitude of students who show confidence in the learning process. Students learn on their own whether there is a teacher or there is no teacher. Students are motivated to engage in activities to prepare and study material before and after learning activities from various sources, namely textbooks, e-modules, and the internet; development of E-modules assisted by sigil software on enumeration materials produced in a digital form packaged using sigil software. The resulting e-module product is equipped with text, image, and video content. In addition, e-module products assisted by sigil software consist of components which include, table of contents, concept maps, basic competencies, learning objectives, history, contextual problems, materials, summaries, questions, posttests, discussions, and references in files. MS word is then saved in the form of a Web Page, Filtered (*.htm;*html) which is then converted using sigil software. Furthermore, all the content into one file in the form of text, images, and videos into an epub file. This epub file can be opened on a laptop/PC by using the Readium application on Google Chrome. Meanwhile, to open epub files on a smartphone using the epub reader application or easily which can be downloaded via google play store on a smartphone. The use of e-modules assisted by sigil software on enumeration materials that are suitable for use and have a significant effect on the mathematics learning process; the resulting product is effective for use in improving critical thinking skills, as evidenced by the material expert's right of 4.19, the media expert's assessment of 3.97.

Recommendations

Based on the results of the study and the conclusions obtained, the following suggestions can be submitted: (1) This e-module needs to be developed again on other materials because in this study only material for enumeration rules was developed, (2) The use of e-module products assisted by sigil software, the teacher should re-explain the material or practice questions contained in it, (3) The teacher first explains about the product and its use with the aim that it is easier for students to understand the material presented in the e-module product assisted by sigil software, (4) Because there is still a lack of prior knowledge of students and this has an impact on the test and learning process, for further researchers to conduct a more in-depth preliminary study of these mathematical problems.

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Appendix 1.

Interview Question

1. What do you think about math?
2. What do you think about how to teach teachers in the classroom (teacher lectures)?
3. In your opinion, what is fun math learning like?
4. What do you think about realistic learning related to everyday life?
5. Have you studied mathematics using e-modules, did it make you understand and understand more about the material of counting rules?
6. According to your experience, is it possible to solve math problems after using the e-module assisted by sigil?
7. Are you trying to find alternative methods of solving problems?
8. Do you have the interest and curiosity to get solved math problems?
9. Are there any suggestions and criticisms regarding the mathematics learning that I did during the research?

Questioner

1. Clarity of the formulation of learning objectives
2. Relevance of goals with KI, KD
3. The suitability of the material with the purpose
4. Material update
5. Material depth
6. The systematic, coherent, clear logic flow
7. Clarity of question formulation
8. Completeness of questions
9. The truth of the question concept
10. Providing feedback on the evaluation results
11. Consistency of evaluation with learning objectives
12. Communicative on language
13. Accuracy in the use of terms
14. Giving the motivation to learn
15. Student activities

Material Expert Validation Questions

A. Hint

This validation questionnaire is filled out by material experts who master their fields
This validation questionnaire is intended to obtain information from you as a material expert regarding the quality of the product of teaching materials for mathematics subjects that are being developed.
Answers are given in the column of the rating scale that has been provided, with the rating scale:
5 = Very good
4 = Fine
3 = Enough
2 = Not Good
1 = Very Poor
Please put a tick (√) in the column of the rating scale that corresponds to your opinion
Please provide comments and suggestions in the space provided.
No Assessment Question
1 2 3 4 5
Material Aspect
1 Learning objectives are formulated
2 The material delivered is by KI, KD
3 The material delivered is by the learning objectives
4 The material delivered is actual
5 Materials delivered in complete media
6 The material is delivered clearly
7 Materials are delivered systematically
8 The material presented is packaged in an attractive way

9 The material presented is easy to understand
Aspects of Questions
10 Questions are formulated
11 Questions in complete media media
12 Questions according to theory and concepts
13 Answer keys according to the question
14 There is feedback on the evaluation results
15 Evaluation is consistent with learning objectives
Language Aspect
16 The language used is communicative
17 The terms and questions used are appropriate and appropriate
Implementation Aspect
18 The material can be understood by students
19 The material presented attracts students' attention
20 Students are more active in doing learning activities

B. Comments and Suggestions
....
....
....
....
....
....
....

C. Conclusion
This medium is stated *)
1. Worth trying out
2. Worth testing with revisions according to suggestions
3. Not worth trying out
*) Choose one by circling the appropriate conclusion

Bandung, ...
Material Expert

(_____)

Media Expert Validation Questions
A. Hint
This validation questionnaire is filled out by media experts who are experts in their fields
This validation questionnaire is intended to obtain information from you as a media expert regarding the quality of the product of teaching materials for mathematics subjects that are being developed.
Answers are given in the column of the rating scale that has been provided, with the rating scale:
5 = Very good
4 = Fine
3 = Enough
2 = Not Good
1 = Very Poor
Please provide comments and suggestions in the space provided.
Display Aspect
1 Clarity of the title of teaching materials
2 The legibility of sentence structure makes it easier for students to learn
3 Appropriate use of color proportion
4 Accuracy of background color selection
5 Compatibility of font selection
6 Appropriateness of font size selection

7 Clarity of the display of supporting images of the material
8 Clarity of display animation supporting material
9 Clarity of video display supporting material
10 Interesting pictures in the content of teaching materials
11 The attractiveness of animation in the content of teaching materials
12 Interesting videos in the content of teaching materials
13 The beauty of the cover
14 The suitability of the cover design with the material
15 Customization of the main menu button display (bookmark display, print, and logout)
Aspects of Use
16 Ease of use of the product
17 Precise use of buttons and navigation
18 Ease of accessing the product menu (back to the desired page)
19 Ease of interacting with the product
20 Ease of access out of the product
21 Completeness of module identity
Utilization Aspect
22 Compatibility of teaching material components with module systematics (cover, concept map, basic competence, learning objectives, history, contextual problems, materials, quiz summary, post-test, references)
23 The suitability of the language used communicative
24 contemporary material
25 Has a visual appeal that includes colors, images, illustrations, font shapes, and sizes (bold, italics, underlines)
26 The accuracy of giving feedback on student input
27 Possibility of students doing self-assessment

B. Comments and Suggestions
....
....
C. Conclusion
This medium is stated *)
1. Worth trying out
2. Worth testing with revisions according to suggestions
3. Not worth trying out
*) Choose one by circling the appropriate conclusion

Bandung, ...
Media Expert
(_____)