Improve Concept Understanding and Identifiability Using E-Modul Interactif Microalga

Shohifa Aulia Akbar[1*], Diana Vivanti Sigit[2], Ratna Komala[3] iD

[1,2,3] Biology Education, Universitas Negeri Jakarta, Jakarta, Indonesia

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ABSTRAK

Kesulitan siswa dalam memahami dan mengidentifikasi berbagai bentuk mikroalga berdampak negatif terhadap hasil belajarnya. Akibatnya siswa menjadi semakin bosan dengan proses pembelajaran. Tujuan dari penelitian ini adalah mengembangkan E-modul interaktif untuk meningkatkan pemahaman konsep dan keterampilan identifikasi mikroalga. Penelitian ini menggunakan prosedur penelitian dan pengembangan (R&D) dengan menggunakan model pengembangan ADDIE. Subyek penelitian ini adalah satu orang ahli media, satu orang ahli materi, satu orang ahli desain, dua orang dosen biologi untuk analisis kebutuhan, sembilan orang mahasiswa untuk uji coba tunggal, dan delapan belas orang mahasiswa untuk uji coba kelompok kecil. Metode yang digunakan untuk mengumpulkan data adalah observasi dan wawancara. Instrument pengumpulan data menggunakan kuesioner. Teknik analisis data menggunakan analisis deskriptif kualitatif, kuantitatif, dan uji N-gain. Hasil penelitina yaitu E-modul interaktif secara keseluruhan memperoleh kriteria sangat layak berdasarkan hasil uji validasi ahli dengan persentase lebih besar dari 80%. Berdasarkan hasil perhitungan uji N-Gain, rata-rata variabel pemahaman konsep sebesar 0,84, sedangkan variabel keterampilan identifikasi sebesar 0,70 menunjukkan nilai gain lebih besar dari 0,7 yang berarti sangat berhasil. Disimpulkan E-modul interaktif dinyatakan praktis dan efektif untuk meningkatkan pemahaman konsep dan keterampilan identifikasi siswa.

ABSTRAK

Students' difficulties understanding and identifying various forms of microalgae hurt their learning outcomes. As a result, students become increasingly bored with the learning process. This research aims to develop an interactive E-module to improve conceptual understanding and microalgae identification skills. This research uses research and development (R&D) procedures using the ADDIE development model. The subjects of this research were one media expert, material expert, design expert, biology lecturers for needs analysis, nine students for single trials, and eighteen students for small group trials. The methods used to collect data are observation and interviews. The data collection instrument uses a questionnaire. The data analysis technique uses qualitative, quantitative descriptive analysis and the N-gain test. The research results, namely that the interactive E-module obtained very feasible criteria based on the results of expert validation tests with a percentage greater than 80%. Based on the N-Gain test calculation results, the average concept understanding variable is 0.84, while the identification skills variable is 0.70, indicating a gain value greater than 0.7, which means it is very successful. It was concluded that the interactive E-module was practical and effective in improving student's understanding of concepts and identification skills.

1. INTRODUCTION

Microalgae is one of the biological elements covered in Basic Competency (KD) 3.6, which deals with categorizing protists based on their properties and role in the environment. Most students believe that microalgaecontent is tough to understand since it has the competency to attain student learning outcomes such as knowing one example of a microalgae organism. According to the findings of observations and interviews with biology class X teachers at SMA Negeri 1 Kragilan, there are several issues related to students' learning limitations, such as first, Microalgae material has sub-subject matter that is very little

described in circulating printed books, but is very broad. the scope of the conversation. Second, A lack of textbooks for students and teachers. Third, Existing textbooks are outdated releases, thus the contents must be revised to reflect the most recent curriculum. This leads to a lack of conceptual grasp of given material among students and makes them inefficient in acquiring knowledge (Harlis & Budiarti, 2019; Kowiyah et al., 2019; Zaki et al., 2020). Coupled with the teacher's teaching methods, which are still traditional and mainly focus on textbooks, pupils are not learning optimally (Agustiana et al., 2020; Purwandari & Wahyuningtyas, 2017; Wulandari et al., 2019).

Situations like this encourage the development of new technology to build learning media that can encourage students to learn and improve conceptual understanding and identification skills in identifying the taxonomy of microalgae. Understanding concepts is the ability to grasp understandings, such as being able to express material presented in a more understandable form, being able to provide interpretations and being able to apply them (Andriani et al., 2019; Ariyanto et al., 2020; Cahani et al., 2021; Safi'i & Bharata, 2021). Concept understanding is a level of ability that expects students to understand the meaning of the concepts, situations and facts they know (Andini & Supriadi, 2018; Farida et al., 2019; Harrell & Subramaniam, 2015). Increased student skills in distinguishing different forms of microalgae aid conceptual knowledge. A person's skill is their ability or aptitude to accomplish specific activities. The process of introducing a new taxon by comparing or equating the findings with earlier examples is known as identification. Identification can be understood as a method of grouping specific types of species after classification by making comparisons with pre-existing species (Hayati & Sujadi, 2018). According to the aforementioned definition, microalgae identification abilities are the ability of pupils to group types of microalgae species based on pre-existing species.KD 4.6, including organizing the process of observing activities, carrying out observations, and presenting the outcomes of observations, is used to measure microalgae identification skills. Identification abilities are used to identify the microalgae species that have been discovered

The right solution to increase understanding of concepts is to design interesting learning media that meets students' needs. This learning media is a teaching tool to increase student achievement and motivation (Astutik et al., 2021; Risabethe et al., 2017; Surata et al., 2020). Therefore, learning media designed to attract children's interest must have characteristics that are easy to understand and pleasing to the eye. Previous research findings also state that well-designed learning media can help students learn (Habibi & Setyaningtyas, 2021; Laksmi & Suniasih, 2021; Rahmat et al., 2019). One of the learning media that can be used is interactive electronic modules. Interactive electronic modules are one of the educational elements used to improve conceptual understanding and identification skills (Wangi et al., 2021). The interactive e-module was stated to be practical and effective in improving conceptual understanding and identification skills for class X high school students. Interactive e-modules based on microalgae are currently uncommon. As a result, the presence of interactive E-modules can stimulate students' thinking abilities and provide the effect of a contextual learning process by conceptually applying knowledge. This interactive e-module can provide real-world experience, increasing meaning and encouraging pupils to think creatively and innovatively about their learning. Theinteractive E-module also makes it easy for pupils to learn whenever and wherever they desire (Alwan, 2018; Fadhilah, 2019; M. Y. Lestari & Diana, 2018; Rahayu, I., & Sukardi, 2021; Sofyan et al., 2019). Interactive E-modules are particularly significant in the learning process since they are a source of knowledge for students, especially to assist learning activities in schools. Furthermore, interactive E-modules can predict students' achievement in specific courses (Aqil, 2017; Rahayu, I., & Sukardi, 2021; Sofyan et al., 2019). Bloom defines understanding as the ability to rephrase something in an easy-to-understand manner, convey it, and apply it. Understanding concepts is the ability of a person, in this example pupils, to grasp a concept and interpret it without changing its real meaning (Deliany et al., 2019; Dewi & Primayana, 2019).

Understanding of ideas is examined using KD 3.6, in which students can recall many species present in nature and understand their ecology. Students can support numerous elements of conceptual comprehension by participating in the module's activities, which include applying, analyzing, evaluating, and producing. Understanding concepts in the learning process is critical for integrating science and technology in real life in thesurrounding environment (Ariyanto et al., 2020; Kowiyah et al., 2019; Safi'i & Bharata, 2021). Students' lack of conceptual comprehension leads to subpar learning outcomes, which reduces students' competitiveness in comparison to contemporary advances. Concept knowledge is good if these children can demonstrate markers of concept understanding (Effendi, 2017; Septihani et al., 2020; Trianggono, 2017). There are seven signs of conceptual knowledge that relate to the cognitive understanding process in accordance with Bloom's revised taxonomy, namely interpreting, exemplifying, classifying, summarizing, guessing, comparing, and explaining (Anderson & Krathwohl, 2001).

There is a gap or research gap in every study. The existence of diverse research results using the same research method and data analysis is the research gap in this study. According to research, an expert

validation test result of 93.4% and a student response test result of 95% were obtained (Pramana et al., 2020), whereas other research obtained an expert validation testresult of 93.76% and a student response test result of 78.5% (Prihatiningtyas et al., 2021). Furthermore, according to research,the average result of E-module validation is higher than the Pramana and Prihatiningtyas research, namely 99.3%, while for the student response test it is 92%, which is lower than the Pramana research but higher than the Prihatiningtyas research (Winatha, Naswan, et al., 2018). As a result of the preceding research, the most recent research on the development of an interactive microalgae E-module to promote concept understanding and identification abilities for class X SMA may be made. This study includes a feasibility and effectiveness test to determine the viability and efficacyof using interactive E-modules. Previous research findings also state that E-modules are very necessary in learning because they make it easier for students to study anywhere (Darmaji et al., 2019; Farenta et al., 2016; Triwahyuningtyas et al., 2020).

The benefits of this e-module are that it is composed of navigation in the form of links that make it easier for students to use, that it is easy to access anytime and anywhere based on students' needs, that it contains multimedia features to increase students' literacy understanding and reading interest, that it contains text, images, audio, and videos, and practice questions/quizzes that can help students' understanding process, and that it can motivate students in learning so that learning becomes more enjoyable (Aprilia & Suryadarma, 2020; Hadiyanti et al., 2021; Purnamasari et al., 2020; Sari & Manuaba, 2021). The prepared teaching materials are in accordance with the media and learning objectives, in accordance with the media and students' interests and characteristics, and in accordance with the media and learning materials and are used as a substitute for printed modules that are more dynamic and emphasize optimal understanding of lessons (Erna et al., 2021; Laili et al., 2019; Winatha, Naswan, et al., 2018). Making interactive E-modules is accomplished through the use of Google Sites in the form of a website that can be visited via any platform appropriate for classroom learning.

Therefore, the aim of this research is to develop an interactive E-module to improve conceptual understanding and microalgae identification skills for high school classes. The novelty of this study is meant to supplement previous research, such as on Project-based Interactive E-module Development (Winatha, Naswan, et al., 2018), research on Textbook Development with the ADDIE Model (Tegeh et al., 2015), and research onAlgae teaching can be utilized as instructional material to increase students' conceptual understanding and microalgae identification skills (Harlis & Budiarti, 2019), as well as a literature review and reference for future research.

2. METHOD

This study employs research and development (R&D) methods, specifically research that results in a specific product using the ADDIE development paradigm (Analysis, Design, Development, Implementation, andEvaluation) (Cahyadi, 2019). The ADDIE model was chosen for several reasons, including: the ADDIE model was developed systematically and is based on theoretical foundations in learning; it is structured programmatically in an effort to solve learning problems; the ADDIE model has five stages that are easily understood and implemented; the ADDIE paradigm can be used to design learning materials in the areas of verbal, intellectual, psychomotor skills, and attitudes, with product review occurring at each stage to reduce errors or product defects. This study's subjects included three learning specialists, including media experts, material experts, and design experts, as well as nine students for individual trials and eighteen students for small group trials. The trial took place in classes X IPA 1, X IPA 2, and X IPA 3. The methods used to collect data are observation and interviews. To assess the findings of the needs analysis of biology students and teachers, data was collected in this study using observation and interview methods. Data was collected through interviews using systematic questions and answers, and the results were meticulously recorded (Agung, 2017). Student and biology teacher needs analysis sheets, media expert validation sheets, material expert validation sheets, design expert validation sheets, individual trial results assessment sheets, and small group trial results assessment sheets are among the instruments utilized. A student needs analysis sheet was the first study instrument. This analysis sheet is designed to collect input from students about their understanding of the biology of protist material, particularly microalgae. A biology teacher needs analysis form served as the second study instrument. This instrument was designed to gather information from biology teachers about their understanding of explaining and teaching biology subjects about protists, particularly microalgae.

The technique used to analyze data is qualitative and quantitative descriptive analysis. The collected results were subjected to both qualitative and quantitative descriptive analysis. The qualitative descriptive analysis approach is derived from the findings of the study, which take the form of input, reactions, criticism, and ideas from specialists on the medium under development. Meanwhile, the quantitative descriptive analysis approach is derived from the numerical results of data processing to determine the value assigned by experts to the media under development. The analysis results will be

descriptively analyzed and explained in order to determine development needs. As evaluation material for the E-module being produced, learning media specialists' product validation instruments are used. The validation instrument developed by media specialists covers four criteria aspects: look, presentation, quality, and programming. The validation instrument developed by material experts covers four criteria aspects: content suitability, presentation, linguistics, and autonomous learning. The validation instrument developed by learning design professionals covers three criteria aspects: curriculum, method, and evaluation. Individual trial instrument consists of six criteria aspects: learning media, resources, language, interactive, evaluation, and benefits. The validation test results are calculated to identify the product's feasibility, then assessed and recapitulated the feasibility level using the feasibility level conversion (Arikunto & Suharsimi, 2009). An efficacy test was performed utilizing the N-gain test to determine the effectiveness of the E-module. The efficacy test results are calculated and analyzed using the N-gain standardization criterion, as shown in Table 1. Data from individual trials and small group trials were evaluated descriptively and interpreted into studentresponse criteria (Saselah et al., 2017).

Table 1. Standardization Criteria for N-gain

N-gain Result	Criteria
$g > 0.7$	High
$0.3 \leq g < 0.7$	Low
$g < 0.3$	Medium

3.   RESULT AND DISCUSSION
Results

The ADDIE learning paradigm is used in the process of building interactive microalgae E-modules, which consists of various steps beginning with analysis. The first step is to analyze. At this step, the needs of pupils and biology teachers will be assessed. According to the findings of the needs analysis, 100% of students had student handbooks for studying Biology, and 90% of students thought algal content was difficult to understand. According to the findings of the analysis of biology instructors' demands, they strongly agreed if biology teaching materials based on protist material, particularly microalgae, were generated, and they strongly agreed if the teaching materials were developed in the form of interactive E-modules. The second stage is the design. At this stage, (1) a storyboard was created, (2) an E-module framework was created, (3) an E-module design was created, (4) assessment instruments were created, and (5) a learning implementation plan (RPP) was created as guidance in learning activities using interactive E-module teaching materials. Protist material regarding plant-like protists (Algae) is used in this E-module. After creating the storyboard, build E-module supporting assets in Microsoft Word 2010. The finished E-module design is then discussed with the supervisor to receive recommendations and feedback on the design. The next stage, namely the development of the E-module, was carried out based on the supervisor's input.

The second stage is the design (Design). At this stage, (1) a storyboard was created, (2) an E-module framework was created, (3) an E-module design was created, (4) assessment instruments were created, and (5) a learning implementation plan (RPP) was created as guidance in learning activities using interactive E-module teaching materials. Protist material regarding plant-like protists (Algae) is used in this E-module. After creating the storyboard, build E-module supporting assets in Microsoft Word 2010. The finished E-module design is then discussed with the supervisor to receive recommendations and feedback on the design. The goal of this validation is to perfect the product being produced so that it may be used by biology students and teachers during learning. Figures 1–5 depict the appearance of the microalgae material biology learning E-module. The results of the E-module development are presented in Figure 1.

Figure 1. E-module Development Results

The fourth stage is implementation. The goal of the implementation is to establish the viability of interactive E-modules when they are used by students. Validation tests are carried out during this stage by media experts, material experts, and learning design experts. Following validation, the product was revised in accordance with the validator's suggestions and comments. Following that, we tested the product on nine students individually and eighteen students in small groups. The developed goods are subsequently put to validation testing by professionals to determine the E-module's validity. Following that, data was analyzed by computing the scores collected from media experts, material experts, and design experts. The interactive microalgae E-module validation exam seeks to determine the E-module's eligibility, usefulness, and the increase in students' conceptual comprehension and identification skills. The validation results for the research instruments that have been tested, showed in Table 2.

Table 2. Instrument Validation Results

Trial subject	Nilai Validitas (%)	Criteria
Media Expert Test	91	Very valid
Material Expert Test	92	Very valid
Desain Expert Test	91	Very valid
Individual Trials	90.1	Very Good
Small Group Trials	90.4	Very Good

According to the results in Table 2, the media expert validation test obtained a validity value of 91% with the criteria "very valid," indicating that the quality of learning media improved. The material expert validation test results got a validity value of 92%, with the criteria "very valid," indicating an increase in the quality of the material content in the interactive E-module. The learning design validation test results received a validity score of 91%, with the criteria "very valid" indicating that there is a comparison of the results of the product design that has been created that is effective and different from the old product, so it can be said to be suitable and valid for use. Individual trials conducted by nine students yielded a percentage of 90.1%, whereas small group trials conducted by eighteen students yielded a percentage of 90.4%. The criteria were "very good" based on the results of individual trials and small group trials, indicating that the interactive e-module was good and suitable for use in learning. The given instrument validation yielded a percentage of 80%, indicating that the interactive E-module is very valid for use in teaching and learning by teachers and students. As a result, the interactive microalgae E-module developed to increase concept understanding and identification skills for class X SMA is reported to be ideal for classroom application.

The fifth and last stage is the evaluation. At this stage, review the interactive E-module product that has been created in order to assess the achievement of product development goals in the form of digital teaching materials. Furthermore, researchers evaluate generated products by (1) analyzing product trials and (2) producing the final product in the form of interactive E-modules suited for use in learning activities. Based on the data collected above, it can be determined that the microalgae interactive E-module is highly feasible to use, although there are a few aspects that need to be improved. Expert suggestions and comments can be utilized as input and considered in order to improve this E-module. To evaluate the effectiveness of the E-module, you must first complete numerous prerequisite tests, such as the normality test, Wilcoxon test, and N-Gain test. The results of the N-gain test on the idea understanding variable showed in Table 3.

Table 3. N-Gain Test Results for Concept Understanding

Indicator	N-Gain Score	Criteria
Interpret	0.89	High
Give an example	1.11**	High
Classify	0.40	Medium
Summarize	1.07	High
Guess	1.03	High
Compare	1.02	High
Explain	0.38*	Medium
Mean N-Gain	**0.84**	**High**

Description: *Lowest, **Highest

According to Table 3, the average calculation result of the N-Gain test on the conceptual understanding variable is 0.84, indicating that the gain value is larger than 0.7, indicating that it is highly successful. The exemplary indicator receives the highest N-Gain score, while the explanatory indicator

receives the lowest. The results of the N-gain test on the identifying skills variable, showed in Table 4.

Table 4. N-Gain Test Results for Identification Skills

Indicator	N-Gain Score	Criteria
Planning	0.82**	High
Implementing	0.79	High
Presenting	0.49*	Medium
Mean N-Gain	**0.70**	**High**

Description: *Lowest, **Highest

Discussion

This research resulted in the creating of an interactive microalgae E-module for class X SMA/MA students. This e-module was created to help people understand the concept and identify microalgae species. The results of this research conclude that the interactive microalgae E-module is suitable for use in learning due to several factors. First, the interactive microalgae E-module is suitable for learning because it can increase students' understanding of concepts. This e-module can be used as a source for selecting textbooks on protists. Previous research findings also state that students can use well-developed E-modules in learning (Imansari & Sunaryantiningsih, 2017; Pathoni et al., 2017; Priatna et al., 2017). The e-module developed has been integrated into the curriculum by the basic competencies taught in class. It must be done so that the E-module developed is appropriate (Elvarita et al., 2020; Laili et al., 2019; Ramadayanty et al., 2021). The microalgae interactive e-module received very valid criteria based on the expert evaluation of the learning material. 1) suitability of the topic, 2) presentation aspects, 3) language that is easy to understand, and 4) interesting E-modules are indicators of very good qualifications. Previous findings state that coherent (systematic) material can help students understand the material from a basic level to a more sophisticated level, thereby enabling students to learn more independently (Winatha et al., 2020; E. Lestari et al., 2022). Linguistic aspects include using language that is easy to understand, using clear, precise sentences that do not produce double meanings, and using language that is appropriate to the student's level of development. It is supported by research, one of which is using appropriate and correct language in preparing good teaching materials (Florentina Turnip & Karyono, 2021; Solikin, 2018). However, the linguistic aspect is low because many scientific names in microalgae material are difficult for students, even biology teachers, to understand. According to research, understanding biology involves conceptions that come from real scientific facts and concepts that come from abstract things (Aisyiyah & Amrizal, 2020). According to other research, students will have difficulty studying biology with real understanding but will be challenged if it is integrated on a microscopic and macroscopic scale (Noviati, 2020).

Second, the interactive microalgae E-module is suitable for learning because it can improve students' identification skills. Based on the N-Gain test results, for example, a score of 1.11 is included in the high category. It shows that some students were able to model certain microalgae divisions. Research on the use of learning media has positively impacted students' identification skills (Khoiri et al., 2018). It explains why the exemplary indication is included in the high category. Presenters increasingly provide content in the form of examples that relate it to the educational sphere, thereby causing a real increase in exemplary indicators (Nurdin et al., 2019; Susanti, 2019). The microalgae interactive e-module received very valid criteria based on the results of a design expert review. Qualifications are rated as very good based on 1) curriculum aspects, 2) method aspects, and 3) evaluation factors. Learning objectives determine the length of information written in the E-module, and the evaluation carried out is also adjusted to learning indicators (Elvarita et al., 2020; Laili et al., 2019; Ramadayanty et al., 2021; Winatha, Naswan, et al., 2018). The evaluation element was reported to be low due to the lack of clarity in assignment instructions, clarity in measuring learning outcomes, and relevance of questions to learning objectives. Experts think this E-module learning design is suitable for use, but in the assessment aspect, it is required to provide clear instructions for carrying out tasks and adapt them to student ability standards. This e-module can make it easier for teachers to explain the content of microalgae and make it easier for students to understand the diversity of microalgae.

Third, the interactive microalgae E-module is suitable for learning because it can make learning easier for students. Apart from that, the development of E-modules is made more interesting and easy to access anytime and anywhere by utilizing digital devices to make it easier for students to learn (Imansari & Sunaryantiningsih, 2017; Pathoni et al., 2017; Priatna et al., 2017). This e-module was created after studying the needs of students in the sector. The findings of the validity test of the microalgae interactive E-module show very valid criteria, indicating that the interactive E-module is very suitable for use in the learning process. It is because the E-module development process has been carried out systematically,

starting from analysis, design, development, implementation, and evaluation and ending with a product that has been improved and is suitable for use in learning. The microalgae interactive e-module received excellent criteria based on individual and small-group trial results. It is in line with research which finds that good qualifications can be achieved through various factors, including (1) ease of use, (2) attractive appearance, and (3) communicative and simple language (Idiajir & Daryati, 2021; Pramana et al., 2020; Seruni et al., 2019). The ease of use of E-modules can give students the confidence to access study materials themselves (Diantari et al., 2018; Marsitin et al., 2018; Winatha, et al., 2018). Students will be more motivated to learn when the teaching materials are interesting and easy to understand thanks to the use of communicative language (Asrial et al., 2020; Wijayanti & Ghofur, 2021).

E-modul interaktif microalga is effective and can be used as a teaching tool since it contributes to the success of didik learners' learning. This is based on the results of the pretest, posttest, and the evaluation of the effectiveness of the students in class X at SMA Negeri 1 Kragilan. According to the results of the pretest and posttest, a significance level of .000 0.05 was determined, and as a result, there are different rate-of-change thresholds depending on whether instruction includes interactive electronic modules or does not. According to the results of the effectiveness test using N-Gain, the results of the tests were 1.11 for understanding the principle and 0.82 for understanding identifiability of the participant in the experiment after the E-module was introduced. This indicates that there was improvement in both of these measures.

4. CONCLUSION

The results of the feasibility test on the average of microalgae interactive E-modules to enhance conceptual understanding and identification skills for class X SMA are feasible to be used in student learning activities, it can be concluded based on the findings and discussion of the research that has been done. According to the efficacy test results, the usage of microalgae class X SMA in student learning activities was found to be effective in improving concept understanding and identification skills.

5. REFERENCES

Agung, A. A. G. (2017). Metodologi Penelitian Kuantitatif (Perspektif Manajemen Pendidikan). *Singaraja: Universitas Pendidikan Ganesha*.

Agustiana, I. G. A. T., Agustini, R., Ibrahim, M., & Tika, I. N. (2020). Perangkat Pembelajaran (RPS dan SAP) IPA Model (OPPEMEI) untuk Meningkatkan Keterampilan Berpikir Kreatif Mahasiswa PGSD. *Jurnal Ilmiah Sekolah Dasar*, *4*(2), 309–323. https://doi.org/10.23887/jisd.v4i2.25190.

Aisyiyah, A. T. P., & Amrizal, A. (2020). Penerapan Pendekatan Saintifik (Scientific Approach) Dalam Pembelajaran Biologi SMA. *Jurnal Pelita Pendidikan*, *8*(4), 215–23. https://doi.org/10.24114/jpp.v8i4.20856.

Alwan, M. (2018). Pengembangan Multimedia E-Book 3D Berbasis Mobile Learning Untuk Mata Pelajaran Geografi SMA Guna Mendukung Pembelajaran Jarak Jauh. *At-Tadbir STAI Daru; Kamal NW Kembang Kerang*, *1*(2), 26–40. https://doi.org/10.3454/at-tadbir.v1i2.3009.

Anderson, L. W., & Krathwohl, D. R. (2001). *Taxonomy For Learning, Teaching, And Assesing; A Revision Of Blom's Taxonomy*. Longman Publishing.

Andini, D., & Supriadi, N. (2018). Media Animasi Menggunakan Macromedia Flash Berbasis Pemahaman Konsep Pokok Bahasan Persegi dan Persegi Panjang. *Desimal: Jurnal Matematika*, *1*(2), 149. https://doi.org/10.24042/djm.v1i2.2278.

Andriani, M., Muhali, M., & Dewi, C. A. (2019). Pengembangan Modul Kimia Berbasis Kontekstual Untuk Membangun Pemahaman Konsep Siswa Pada Materi Asam Basa. *Hydrogen: Jurnal Kependidikan Kimia*, *7*(1), 25. https://doi.org/10.33394/hjkk.v7i1.1653.

Aprilia, I., & Suryadarma, I. G. P. (2020). E-module of mangrove ecosystem (emme): development, validation and effectiveness in improving students' self-regulated. *Biosfer: Jurnal Pendidikan Biologi*, *13*(1), 114–129. https://doi.org/10.21009/biosferjpb.v13n1.114-129.

Aqil, D. I. (2017). Literasi Sains sebagai Konsep Pembelajaran Buku Ajar Biologi di Sekolah. *Wacana Didaktika*, *5*(02), 160–171. https://doi.org/10.31102/wacanadidaktika.5.02.160-171.

Arikunto, & Suharsimi. (2009). *Dasar-dasar evaluasi pendidikan*. PT Bumi Aksara.

Ariyanto, L., Rahmawati, N. D., & Haris, A. (2020). Pengembangan Mobile Learning Game Berbasis Pendekatan Kontekstual Terhadap Pemahaman Konsep Matematis Siswa. *JIPMat*, *5*(1), 36–48. https://doi.org/10.26877/jipmat.v5i1.5478.

Asrial, Syahrial, Maison, Kurniawan, D. A., & Piyana, S. O. (2020). Ethnoconstructivism E-Module to Improve Perception, Interest, and Motivation of Students in Class V Elementary School. *JPI (Jurnal Pendidikan Indonesia)*, *9*(1), 30–41. https://doi.org/10.23887/jpi-undiksha.v9i1.19222.

Astutik, A. F., Rusijono, & Suprijono, A. (2021). Pengembangan Media Komik Digital Dalam Pembelajaran IPS Sebagai Penguatan Karakter Peserta Didik Kelas V SDN Geluran 1 Taman. *Jurnal Education and Development Institut Pendidikan Tapanuli Selatan*, *9*(3), 543–554. https://doi.org/https://doi.org/10.37081/ed.v9i3.2894.

Cahani, K., Effendi, K. N. S., & Munandar, D. R. (2021). Kemampuan pemahaman konsep matematika siswa ditinjau dari konsentrasi belajar pada materi statistika dasar. *Jurnal Pembelajaran Matematika Inovatif*, *4*(1), 215–224. https://doi.org/10.22460/jpmi.v4i1.215-224.

Cahyadi, R. A. H. (2019). Pengembangan Bahan Ajar Berbasis Addie Model. *Halaqa: Islamic Education Journal*, *3*(1), 35–42. https://doi.org/10.21070/halaqa.v3i1.2124.

Darmaji, Astalini, Kurniawan, D. A., Parasdila, H., Iridianti, Susbiyanto, Kuswanto, & Ikhlas, M. (2019). E-Module based problem solving in basic physics practicum for science process skills. *International Journal of Online and Biomedical Engineering*, *15*(15), 4–17. https://doi.org/10.3991/ijoe.v15i15.10942.

Deliany, N., Hidayat, A., & Nurhayati, Y. (2019). Penerapan Multimedia Interaktif untuk Meningkatkan Pemahaman Konsep IPA Peserta Didik di Sekolah Dasar. *Educare*, *17*(2), 90–97. http://jurnal.fkip.unla.ac.id/index.php/educare/article/view/247.

Dewi, P. Y. A., & Primayana, K. H. (2019). Effect of Learning Module with Setting Contextual Teaching and Learning to Increase the Understanding of Concepts. *International Journal of Education and Learning*, *1*(1). https://doi.org/10.31763/ijele.v1i1.26.

Diantari, L. P. E., Damayanthi, L. P. E., Sugihartini, N. S., & Wirawan, I. M. A. (2018). Pengembangan e-modul berbasis mastery learning untuk mata pelajaran KKPI kelas XI. *Jurnal Nasional Pendidikan Teknik Informatika: JANAPATI*, *7*(1), 33–47. https://doi.org/10.23887/janapati.v7i1.12166.

Effendi, K. N. S. (2017). Pemahaman Konsep Siswa Kelas Viii Pada Materi Kubus Dan Balok. *Symmetry: Pasundan Journal of Research in Mathematics Learning and Education*, *2*(4), 87–94. https://doi.org/10.23969/symmetry.v2i2.552.

Elvarita, I., A., H., T., & Santoso, S. (2020). Pengembangan Bahan Ajar Mekanika Tanah Berbasis E-Modul pada Program Studi Pendidikan Teknik Bangunan, Universitas Negeri Jakarta. *Jurnal PenSil*, *9*(1), 1–7. https://doi.org/10.21009/jpensil.v9i1.11987.

Erna, M., Anwar, L., & Mazidah, M. (2021). Interactive e-module using Zoom Cloud Meeting platform to reduce misconceptions on salt hydrolysis material. *Journal of Education and Learning (EduLearn)*, *15*(2), 283–290. https://doi.org/10.11591/edulearn.v15i2.18460.

Fadhilah, R. E. (2019). Analisis Kebutuhan Pengembangan Buku Ajar Biologi Umum Materi Bioteknologi Berbasis Penelitian Untuk Mahasiswa S1 Pendidikan Biologi Insttitut Teknologi Dan Sains Nahdlatul Ulama Pasuruan. *Education and Human Development Journal*, *4*(1), 89–95. https://doi.org/10.33086/ehdj.v4i1.1087.

Farenta, A., Sulton, S., & Setyosari, P. (2016). Pengembangan E-Module Berbasis Problem Based Learning Mata Pelajaran Kimia Untuk Siswa Kelas X Sma Negeri 8 Malang. *Jurnal Pendidikan - Teori, Penelitian, Dan Pengembangan*, *1*(6), 1159–1168. https://doi.org/10.17977/jp.v1i6.6460.

Farida, F., Suherman, S., & Zulfikar, S. (2019). Peningkatan Kemampuan Pemahaman Konsep Himpunan Melalui Pembelajaran Matematika dengan Media Articulate Studio'13. *JSHP: Jurnal Sosial Humaniora Dan Pendidikan*, *3*(1), 20–28. https://doi.org/10.32487/JSHP.V3I1.536.

Florentina Turnip, R., & Karyono, H. (2021). Pengembangan E-modul Matematika Dalam Meningkatkan Keterampilan Berpikir Kritis. *Jurnal Edukasi Matematika Dan Sains)*, *9*(2), 485–498. https://doi.org/10.25273/jems.v9i2.11057.

Habibi, C. D., & Setyaningtyas, E. W. (2021). Pengembangan Media Pop-Up Book untuk Kemampuan Pemecahan Masalah pada Pembelajaran Bangun Ruang Kubus dan Balok Kelas V SD. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *05*(02), 1341–1351. https://doi.org/https://doi.org/10.31004/cendekia.v5i2.620.

Hadiyanti, N. F. D., Hobri, Prihandoko, A. C., Susanto, Murtikusuma, R. P., Khasanah, N., & Maharani, P. (2021). Development of mathematics e-module with STEM-collaborative project based learning to improve mathematical literacy ability of vocational high school students. *Journal of Physics: Conference Series*, *1839*(1). https://doi.org/10.1088/1742-6596/1839/1/012031.

Harlis, & Budiarti, R. S. (2019). Development Of Algae Textbooks in Monera and Protista Taxonomy Subjects for Biology Educations Students. *Biodik: Jurnal Ilmiah Pendidikan Biologi*, *5*(3), 215–224. https://doi.org/10.22437/bio.v5i3.7722.

Harrell, P., & Subramaniam, K. (2015). Elementary pre-service teachers' conceptual understanding of dissolving: a Vygotskian concept development perspective. *Research in Science and Technological Education*, *33*(3), 304–324. https://doi.org/10.1080/02635143.2015.1027188.

Hayati, I. R., & Sujadi, E. (2018). Perbedaan Keterampilan Belajar Antara Siswa IPA dan IPS. *Tarbawi : Jurnal Ilmu Pendidikan*, *14*(1). https://doi.org/10.32939/tarbawi.v14i1.250.

Idiajir, K., & Daryati, R. S. (2021). Pengembangan Pembelajaran Berbasis E-Modul pada Mata Kuliah Praktik Mekanika Tanah Development Of E-Module Media-Based Learning In Soil Mechanics Practice Course. *Jurnal Pensil: Pendidikan Teknik Sipil*, *10*, 89–95. https://doi.org/10.31004/cendekia.v5i3.467.

Imansari, N., & Sunaryantiningsih, I. (2017). Pengaruh Penggunaan E-Modul Interaktif Terhadap Hasil Belajar Mahasiswa pada Materi Kesehatan dan Keselamatan Kerja. *VOLT: Jurnal Ilmiah Pendidikan Teknik Elektro*, *2*(1), 11–16. https://doi.org/10.30870/volt.v2i1.1478.

Khoiri, N., Rusilawati, A., Wiyanto, W., & Sulhadi, S. (2018). Mengajarkan Pemahaman Konsep Gerak Parabola Berbantuan Alat Peraga. *Jurnal Penelitian Pembelajaran Fisika*, *9*(2), 119–24. https://doi.org/10.26877/jp2f.v9i2.3108.

Komang Redy Winatha, N., Suharsono, & Agustin, K. (2020). Pengembangan E-Modul Interaktif Berbasis Proyek Matematika. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *4*(2), 188–199. https://doi.org/10.23887/jipp.v4i3.28035.

Kowiyah, K., Mulyawati, I., & Umam, K. (2019). Conceptual Understanding and Mathematical Representation Analysis of Realistic Mathematics Education Based on Personality Types. *Al-Jabar : Jurnal Pendidikan Matematika*, *10*(2), 201–210. https://doi.org/10.24042/ajpm.v10i2.4605.

Laili, I., Ganefri, & Usmeldi. (2019). Efektivitas Pengembangan E-Modul Project Based Learning Pada Mata Pelajaran Instalasi. *Jurnal Imiah Pendidikan Dan Pembelajaran*, *3*(3), 306–315. https://doi.org/10.23887/jipp.v3i3.21840

Laksmi, N. L. P. A., & Suniasih, N. W. (2021). Pengembangan Media Pembelajaran E-Comic Berbasis Problem Based Learning Materi Siklus Air pada Muatan IPA. *Jurnal Imiah Pendidikan Dan Pembelajaran*, *5*(1), 56–64. https://doi.org/10.23887/jipp.v5i1.32911.

Lestari, E., Nulhakim, L., & Suryani, D., W. (2022). Pengembangan E-modul Berbasis Flip Pdf Professional"Tema Global Warming Sebagai Sumber Belajar Mandiri Siswa Kelas VII." *Journal of Science Education*, *6*(2). https://doi.org/10.33369/pendipa.6.2.338-345.

Lestari, M. Y., & Diana, N. (2018). Keterampilan proses sains (KPS) pada pelaksanaan praktikum Fisika Dasar I. *Indonesian Journal of Science and Mathematics Education*, *1*(1), 49–54. http://ejournal.radenintan.ac.id/index.php/IJSME/article/view/2474.

Marsitin, R., Sesanti, N. R., & Agustina, R. (2018). Pelatihan IT Melalui Pembuatan E-modul Matematika bagi Guru Matematika SMK Kabupaten Malang. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang*, *3*. https://doi.org/10.26905/abdimas.v3i0.2647.

Noviati, W. (2020). Kesulitan Pembelajaran Online Mahasiswa Pendidikan Biologi Di Tengah Pandemi Covid19. *Jurnal Pendidikan Mipa*, *10*(1), 7–11. https://doi.org/10.37630/jpm.v10i1.258.

Nurdin, E., Ma'aruf, A., Amir, Z., Risnawati, R., Noviarni, N., & Azmi, M. P. (2019). Pemanfaatan video pembelajaran berbasis Geogebra untuk meningkatkan kemampuan pemahaman konsep matematis siswa SMK. *Jurnal Riset Pendidikan Matematika*, *6*(1), 87–98. https://doi.org/10.21831/jrpm.v6i1.18421.

Pathoni, H., Jufrida, Saputri, I., & Sari, W. (2017). Persepsi Mahasiswa Terhadap E-modul Pembelajaran Mata Kuliah Fisika Atom dan Inti. *Jurnal Eksakta Pendidikan (JEP)*, *1*(1), 55–62. https://doi.org/10.24036/jep/vol1-iss1/35.

Pramana, M. W. A., Jampel, I. N., & Pudjawan, K. (2020). Meningkatkan Hasil Belajar Biologi Melalui E-Modul Berbasis Problem Based Learning. *Jurnal Edutech Undiksha*, *8*(2), 17. https://doi.org/10.23887/jeu.v8i2.28921.

Priatna, I. K., Putrama, I. M., & Divayana, D. G. H. (2017). Pengembangan E-Modul Berbasis Model Pembelajaran Project Based Learning Pada Mata Pelajaran Videografi untuk Siswa Kelas X Desain Komunikasi Visual di SMK Negeri 1 Sukasada. *Jurnal Nasional Pendidikan Teknik Informatika (JANAPATI)*, *6*(1), 70. https://doi.org/10.23887/janapati.v6i1.9931.

Prihatiningtyas, S., Tijanuddarori, M. W., & Sholihah, F. N. (2021). Media Interaktif E- Modul Biologi Materi Virus Sebagai Pendukung Pembelajaran Daring Di MAN 3 Jombang. *Journal of Education and Management Studies*, *4*(3), 1–8. http://ojs.unwaha.ac.id/index.php/joems/article/view/460.

Purnamasari, N., Siswanto, S., & Malik, S. (2020). E-module as an emergency-innovated learning source during the Covid-19 outbreak. *Psychology, Evaluation, and Technology in Educational Research*, *3*(1), 1–8. https://doi.org/10.33292/petier.v3i1.53.

Purwandari, A., & Wahyuningtyas, D. T. (2017). Eksperimen Model Pembelajaran Teams Games Tournament (Tgt) Berbantuan Media Keranjang Biji-Bijian Terhadap Hasil Belajar Materi Perkalian Dan Pembagian Siswa Kelas Ii Sdn Saptorenggo 02. *Jurnal Ilmiah Sekolah Dasar*, *1*(3), 163. https://doi.org/10.23887/jisd.v1i3.11717.

Rahayu, I., & Sukardi, S. (2021). The Development Of E-Modules Project Based Learning for Students of Computer and Basic Networks at Vocational School. *Journal of Education Technology*, *4*(4), 398–403. https://doi.org/10.23887/jet.v4i4.29230.

Rahmat, R. F., Mursyida, L., Rizal, F., Krismadinata, K., & Yunus, Y. (2019). Pengembangan media pembelajaran berbasis mobile learning pada mata pelajaran simulasi digital. *Jurnal Inovasi Teknologi Pendidikan*, *6*(2), 116–126. https://doi.org/10.21831/jitp.v6i2.27414.

Ramadayanty, M., Sutarno, S., & Risdianto, E. (2021). Pengembangan E-Modul Fisika Berbasis Multiple Reprsentation Untuk Melatihkan Keterampilan Pemecahan Masalah Siswa. *Jurnal Kumparan Fisika*, *4*(1), 17–24. https://doi.org/10.33369/jkf.4.1.17-24.

Risabethe, Abiy, & Astuti., B. (2017). Pengembangan Media Pembelajaran UntukMeningkatkan Motivasi Belajar dan Karakter Semangat Kebangsaan Siswa Kelas V Sd. *Jurnal Pendidikan Karakter*, *7*(1). https://doi.org/10.21831/jpk.v7i1.15498.

Safi'i, A., & Bharata, H. (2021). Hubungan Kemampuan Pemecahan Masalah dan Pemahaman Konsep Matematis terhadap Kemampuan Computer Self-Efficacy. *JKPM (Jurnal Kajian Pendidikan Matematika)*, *6*(2), 215. https://doi.org/10.30998/jkpm.v6i2.9826.

Sari, N. M. A., & Manuaba, I. B. S. (2021). Development of Interactive E-Module Based on Human Digestive System Material Inquiry on Theme 3 About Healthy Foods for Fifth Grade Elementary School. *Indonesian Journal Of Educational Research and Review*, *4*(1), 54. https://doi.org/10.23887/ijerr.v4i1.33297.

Saselah, Y. R, M, M. A., & Qadar, R. (2017). Pengembangan Multimedia Interaktif Berbasis Adobe Flash CS6 Professional Pada Pembelajaran Kesetimbangan Kimia. *Jurnal Kimia Dan Pembelajaran Kimia*, *2*(2), 80–89. https://www.academia.edu/download/105838826/11918.pdf.

Septihani, A., Chronika, A., Permaganti, B., Jumiati, Y., Fitriani, N., Siliwangi, I., & Terusan Jenderal Sudirman Cimahi, J. (2020). Analisis kesalahan siswa dalam menyelesaikan soal pemahaman konsep matematika sekolah dasar pada materi bangun datar. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *04*(01), 172–182. https://doi.org/10.31004/cendekia.v4i1.182.

Seruni, R., Munawaoh, S., Kurniadewi, F., & Nurjayadi, M. (2019). Pengembangan Modul Elektronik (E-Module) Biokimia Pada Materi Metabolisme Lipid Menggunakan Flip Pdf Professional. *JTK (Jurnal Tadris Kimiya)*, *4*(1), 48–56. https://doi.org/10.15575/jtk.v4i1.4672.

Sofyan, H., Anggereini, E., & Saadiah, J. (2019). Development of E-Modules Based on Local Wisdom in Central Learning Model at Kindergartens in Jambi City. *European Journal of Educational Research*, *8*(4), 1137–1143. https://doi.org/10.12973/eu-jer.8.4.1137.

Solikin, I. (2018). Implementasi E-Modul pada Program Studi Manajemen Informatika Universitas Bina Darma Berbasis Web Mobile. *Jurnal RESTI (Rekayasa Sistem Dan Teknologi Informasi)*, *2*(2), 492–497. https://doi.org/10.29207/resti.v2i2.393.

Surata, I. K., Sudiana, I. M., & Sudirgayasa, I. G. (2020). Meta-Analisis Media Pembelajaran pada Pembelajaran Biologi. *Journal of Education Technology*, *4*(1), 22–27. https://doi.org/10.23887/jet.v4i1.24079.

Susanti, B. (2019). Penggunaan Media Pembelajaran Video Scribe Untuk Meningkatkan Motivasi Belajar Siswa Kelas V Madrasah Ibtidaiyah At-Taqwa Pinang. *NATURALISTIC : Jurnal Kajian Penelitian Pendidikan Dan Pembelajaran*, *3*(2), 387–396. https://doi.org/10.35568/naturalistic.v3i2.399.

Tegeh, I. M., Jampel, I. N., & Pudjawan, K. (2015). Pengembangan Buku Ajar Model Penelitian Pengembangan Dengan Model ADDIE. *Jurnal Dimensi Pendidikan Dan Pembelajaran*, *3*(1), 24–29. https://ejournal.undiksha.ac.id/index.php/ika/article/view/1145.

Trianggono, M. M. (2017). Analisis Kausalitas Pemahaman Konsep Dengan Kemampuan Berpikir Kreatif Siswa Pada Pemecahan Masalah Fisika. *Jurnal Pendidikan Fisika Dan Keilmuan (JPFK*, *3*(1), 1–12. https://doi.org/10.25273/jpfk.v3i1.874.

Triwahyuningtyas, D., Ningtyas, A. S., & Rahayu, S. (2020). The problem-based learning e-module of planes using Kvisoft Flipbook Maker for elementary school students. *Jurnal Prima Edukasia*, *8*(2), 199–208. https://doi.org/10.21831/jpe.v8i2.34446.

Wangi, N. N. S., Japa, I. G. N., & Renda, N. T. (2021). Mengenal Pecahan Dengan Modul Matematika. *Journal for Lesson and Learning Studies*, *4*(2), 246–54. https://doi.org/10.23887/jlls.v4i2.38327.

Wijayanti, K., & Ghofur, M. A. (2021). Pengembangan Media Pembelajaran E-Modul Bank Dan Sistem Pembayaran Berbasis Android Untuk Peserta Didik Kelas X. *Jurnal Pendidikan Ekonomi*, *14*(1), 2021. https://doi.org/10.17977/UM014v14i12021p001.

Winatha, K. R., Naswan, S., & Ketut, A. (2018). Pengembangan E-modul Interaktif Berbasis Proyek Pada Mata Pelajaran Simulasi Digital Kelas X di SMK TI Bali Global Singaraja. *Jurnal Teknologi Pembelajaran Indonesia*, *8*(1). https://doi.org/10.23887/jtpi.v8i1.2238.

Winatha, K. R., Suharsono, N., & Agustin, K. (2018). Pengembangan E-Modul Interaktif Berbasis Proyek Mata Pelajaran Simulasi Digital. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *15*(2), 188–199. https://doi.org/10.23887/jtpi.v8i1.2238.

Wulandari, F. A., Mawardi, M., & Wardani, K. W. (2019). Peningkatan Keterampilan Berpikir Kreatif Siswa Kelas 5 Menggunakan Model Mind Mapping. *Jurnal Ilmiah Sekolah Dasar*, *3*(1), 10. https://doi.org/10.23887/jisd.v3i1.17174.

Zaki, N. A. A., Zain, N. Z. M., Noor, N. A. Z. M., & Hashim, H. (2020). Developing a conceptual model of learning analytics in serious games for stem education. *Jurnal Pendidikan IPA Indonesia*, *9*(3), 330–339. https://doi.org/10.15294/jpii.v9i3.24466.