

Development of HOTS-Based Interactive E-Modules to Train High School Students' Critical Thinking Skills on Harmonic Vibration Material

 Muhammad Akbar Agustian^{1*},  Afrizal Mayub²,  Dedy Hamdani³

Universitas Bengkulu
Bengkulu, Indonesia

✉ m.akbaragustian2001@gmail.com*



Article Information:

Received November 27, 2023

Revised February 6, 2024

Accepted February 8, 2024

Keywords:

Critical Thinking; Development Research, E-Module; Harmonic Vibration; HOTS

Abstract

The goal of this project is to create an interactive e-module using Hots to teach high school students how to think critically about content related to harmonic vibration that is both realistic and well-received by the students. Thirty-five pupils from class X SMAN 01 Bengkulu City provided the data for this study. The 4D model research method—which stands for Define, Design, Develop, and Disseminate—is used in this study. The study employed many instruments, including observation sheets, student impression sheets, instructor needs questionnaires, and expert team validation sheets. In order to aid students in understanding the teaching materials, the resulting e-module includes text, tables, graphics, formulas, and learning videos. Additionally, an interactive quiz within the e-module allows students to practice their skills. The results of this study indicate that the developed e-module is included in the very feasible category with a value of 87.2%. Students' perception of this e-module is included in the very good category with a value of 84.4%.

A. Introduction

Physics learning is the process of learners (students) interacting with their environment (environment, teachers, books) to acquire logical knowledge, concepts, and facts about objects and nature. Based on the 2013 curriculum, physics is taught not only as a means to convey knowledge, but also as a means to solve everyday life problems and improve the ability to think and act scientifically. However, in reality, these goals are still difficult to achieve due to several factors, such as unmet learning needs, teaching materials that are less contextual and monotonous, and lack of critical thinking habits (Hidayaturrohmah et al., 2017).

According to Prastowo in (Lisa & Susilowibowo, 2016) Teaching materials are any learning resources (texts, information, and tools) that are completely quantified, organized methodically, and examined by students in order to plan and evaluate their own learning. These resources are employed in the learning process. Materials come in a variety of forms, including printed and non-printed materials. Books, handouts, modules, brochures, and student worksheets are examples of printed resources. Audio resources like radios, cassette players, vinyl records, and CDs (Compact Disk) are examples of non-print materials.

One of the innovations utilizing ICT is the creation of printed module materials, sometimes referred to as electronic-based modules or e-modules. According to (Fausih & Danang, 2015) Given the rising affordability of sophisticated technology, modules are typically offered in printed form. However, with the use of computer-assisted electronic technology, modules can also be displayed digitally, or as Electronic Modules. This is in line with the opinion of (Lisa & Susilowibowo, 2016) It describes the creation of educational modules printed in electronic form, or more often known as e-modules, as one application of development through the use of information and communication technology.

As for interactive e-modules according to (Imansari & Sunaryantiningsih, 2017) e-modules are learning resources that include content, approaches, constraints, and techniques for assessment that are methodically and creatively created to attain the desired skills and subcompetencies in accordance with their degree of complexity. In terms of its function, e-modules can replace the role of the teacher, and are presented through electronic media so that they can be accessed anywhere and anytime. Electronic learning modules are one type of instructional resource that can be employed (Syafutri & Pramudya, 2019).

With this electronic module, students can learn more easily without spending too much money. Using these electronic modules also helps students to learn independently. Government electronic modules are not yet fully available in all subjects in schools, especially in vocational schools where there are many productive subjects (Lisa & Susilowibowo, 2016).

Therefore, in this increasingly advanced era, learning carried out in schools cannot be separated from technology. In a lesson, especially physics learning, it is very good if learning activities are carried out using technology, because it can make learning that was previously very difficult for students to understand more interesting, as will the researchers who will develop an electronic module or e-module, where there are several features such as images, videos, and animations. It should be noted that learning requires teaching materials as a guide for a teacher to carry out learning.

One area of education that must be developed greatly is HOTS, as students require both creative and critical thinking skills to solve real-world situations that are not conventional (Susanto and Retnawati, 2016). Developing HOTS requires teachers' ability to plan and manage effective learning. HOTS is a way of improving students' thinking skills at a higher level of thinking (Miterianifa et al., 2021). Higher order thinking skills (HOTS) are the aptitude and experience to solve problems or accomplish objectives using a variety of thought processes (Saptono et al., 2020). Students with HOTS will be capable of assessing, analyzing, and coming up with novel solutions to environmental issues (Ichsan et al., 2019).

Based on learning practices in the field, HOTS learning and assessment is not an easy thing for teachers to implement. Teachers need to be experts in the ideas and techniques of learning (Yayuk et al., 2019). So HOTS-based learning in this day and age is highly recommended to train students' higher order thinking skills. To overcome this problem, there is a need for learning innovations that can be used in student self-learning. One of them is by developing teaching materials in the form of HOTS-based e-modules (electronic modules) that can train students' critical thinking skills in learning using ICT (Information and Communication Technology).

Physics is one of the courses that calls for critical thinking abilities. One of the scientific disciplines that examines a wide range of natural phenomena is physics, which is crucial to the advancement of both science and technology as well as the idea of a harmonious existence. Physics is a subject that can help people become more analytical and rational so that nearly any natural problem can be solved. As a result, improving concept mastery through purposeful learning is essential. Applying critical thinking abilities is one method (Arini & Juliadi, 2018).

A conscious effort that is active, methodical, and based on logic, critical thinking takes into account all points of view in order to comprehend and assess information in order to determine whether it should be accepted, rejected, or postponed (Indah, 2020). A requirement of Curriculum 2013 implementation is critical thinking. Decision-making, strategic planning, the scientific method, and problem-solving are all synonymous with critical thinking. A deliberate, independent process of judgment or decision-making is implied by critical thinking. creation of arguments and considerations based on information about events, situations, ideas, procedures, and standards (Ni Kadek Ayu Suatini, 2019).

This research is also supported by several studies that have been conducted previously, (1) (Marcelina et al., 2022) According to his research on the topic of parabolic motion, "Development of E-Modules Assisted with Videoscribe Simulation to Train Students' Critical Thinking Skills," using instructional materials in the learning process will result in positive student responses, (2) (Puspita, Hidayat, and Wawan Kurniawan 2019) The researcher claimed that after developing and testing electronic modules, a physics electronic module based on a scientific approach to SMA / MA harmonic vibration material using Kvisoft Flipbook Maker was produced that is both valid and workable. This research was titled Development of Physics Electronic Modules Based on a Scientific Approach to Harmonic Vibration Material Using Kvisoft Flipbook Maker. The only simulation in learning activity one, no video or animation in learning activity three, inability to use on smartphones, and inability to connect to the internet are the drawbacks, (3) (Puspitasari et al., 2020) According to his research, "Development of Hots-Based E-Modules Assisted by

Flipbook Marker as Alternative Teaching Materials for Senior High School Students," students can learn new material and utilize E-Modules as a learning tool.

Based on observations and interviews conducted by physics teachers and students at SMAN 4 Bengkulu City, SMAN 1 Bengkulu City and SMAN 8 Bengkulu City, teachers are more likely to teach using teaching materials using printed books or pictures with power point media. And for the difficulties that are often faced by students are difficulties in understanding formulas and also physics concepts. Therefore, researchers conducted research that developed interactive e-module teaching materials, and in the e-module there will be several videos, images and animations, which in the animation can be played by the reader, so that with these features can make students become interested in learning.

Based on the responses to the initial needs questionnaire, which was completed by class X students at SMA Negeri 04, SMA Negeri 01, and class X students at SMA Negeri 08, Bengkulu City, up to 80.75% of students believed that they required electronic teaching materials in order to learn physics in class. Additionally, in order to develop high school pupils' critical thinking abilities regarding harmonic vibration material, HOTS-based electronic modules are required. Without lessening its role as a source of knowledge, printed modules (hardcopy) are replaced with HOTS-based e-modules. It is anticipated that the utilization of instructional resources in the form of interactive e-modules based on HOTS will revitalize students and develop their critical thinking abilities.

B. Research Methods

The research methodology employed is known as research and development, or R&D. According to (Sugiyono, 2014) research and development techniques are techniques used in research to create specific goods and evaluate their efficacy. This kind of study uses a 4-D model research approach and is classified as development research. The four stages of development for this paradigm are define, design, develop, and distribute. The stages are presented in the following figure:

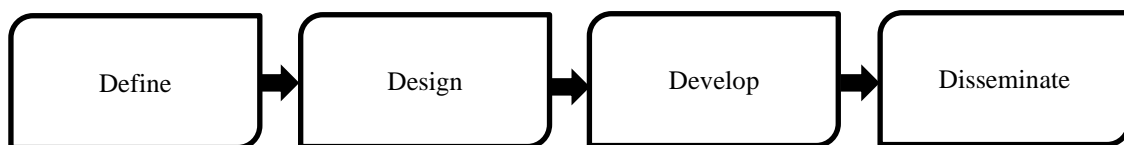


Figure 1. Steps of 4D Development Research

The study was carried out in the 2022–2023 even semester. SMAN 4 Bengkulu City, SMAN 1 Bengkulu City, and SMAN 8 Bengkulu City were the locations of the research.

Data collection techniques were conducted by interview and questionnaire. Interviews were conducted with physics teachers at SMAN 4 Bengkulu City, SMAN 1 Bengkulu City, SMAN 8 Bengkulu City which researchers conducted in a structured manner. The questionnaires used in this development and research are needs analysis filled by students, student perception questionnaires and expert validation questionnaires. In this development and research, the respondents involved for data collection are students, teachers, and validators.

In the data analysis technique in a study, there are two types of data obtained, namely quantitative and qualitative types of data. Data analysis is carried out qualitatively in which there is sentence or word data and aims to determine a characteristic of the e-module research to be developed, the scale that will be used in this study uses a Likert scale. According to (Maryuliana et al., 2016) Likert created the Likert scale, a measurement tool. Four or more question items are integrated on the Likert scale to provide a score or value that indicates unique traits including behavior, attitudes, and knowledge. A composite score, which is often the total or average of all the items, can be utilized in the data analysis process.

C. Results and Discussion

Data stating that HOTS-based e-modules on harmonic vibration material are feasible and well perceived by students are obtained from the results of validity tests conducted by a team of experts consisting of 2 lecturers and 1 teacher as well as student perception tests conducted by 35 students of class X MIPA SMAN 1 Bengkulu City. The research steps to produce products in the form of HOTS-based e-modules, namely:

Define

This defining process was carried out in the early stages of the research. The first activity is problem analysis which is carried out by conducting observations based on observation sheets. Then collecting supporting data to identify the needs of students and teachers is done by distributing student and teacher needs questionnaires.

The results of the observation are that the internet network in SMA is quite good, where the learning method carried out by the school is still conventional, namely still using LKS books and sometimes using power point, therefore this e-module is needed because of the demands of the government which requires students to be active during the learning process, so that teachers must create a learning atmosphere that can make students do activities during the learning process. one of them is by loading interesting teaching materials so that it creates learning attraction for students.

To support the observations made, the researchers took questionnaire data to analyze whether the product to be developed is really needed by students and teachers or not. The distribution of this questionnaire was carried out using a needs analysis questionnaire sheet. Based on the results of the analysis of student needs, a percentage of 80.75% of students were interested in the HOTS-Based Interactive E-module to Train Critical Thinking Skills of High School Students on Harmonic Vibration Material developed and the results of teacher interviews found that teachers were interested in using HOTS-Based Interactive E-modules to Train Critical Thinking Skills of High School Students on Harmonic Vibration Material, after finding the next problem, literature studies and information gathering were carried out.

Literature studies are conducted to gather support for product development. Because the product developed is a HOTS-based interactive e-module, based on the results of the literature study with the implementation of the 2013 curriculum, there are demands for independent learning. Learning activities in the 2013 curriculum must also utilize the role of information and communication technology. This HOTS-based interactive e-module is expected to be used as a learning material for students and can make students learn independently and also train students' higher order thinking skills.

Design

Researchers are already getting ready for the development of e-modules. The content and subject matter of the material that will be presented to students must be pertinent and in line with the syllabus and fundamental skills. This is what needs to be a reference in order for the e-module designed to meet excellent standards. The e-module is created in compliance with the requirements analysis and design once the device and material have been decided upon.

Harmonic vibration in Class X High School is the subject of this study. The 2013 Curriculum informs the adjustments made to the Harmonic Vibration content. The study used harmonic vibration material because it is relevant to a wide range of everyday occurrences, including both technological and natural phenomena. Examples of the application of Harmonic Vibration can be known by students in real life so that they more easily understand the concept of the material presented. The material designed is quoted from several physics print books containing Harmonic Vibration material.

Based on the syllabus, the basic competencies on harmonic vibration material are: 3.11 Analyze the relationship between force and vibration in everyday life 4.11 Conduct harmonic vibration experiments on simple swings and / or spring vibrations and their presentation and physical meaning. Next is designing the e-module format which consists of a cover page, preface, table of contents, glossary, competencies, material, summary, end-of-chapter exercises, bibliography, answer key, and bibliography.

E-modules are designed as learning media that can be used by students anytime and anywhere. E-modules as learning media are more emphasized to train students' critical thinking skills in physics subjects and increase student activeness and creativity presented in e-modules. The initial steps taken in making e-modules are planning teaching material units including syllabus, core competencies and basic competencies and learning materials.

Development

to make a feasibility assessment based on experts who use 5 aspects of assessment in the form of content aspects, presentation aspects, language aspects, media aspects, and aspects of training critical thinking skills. As for assessing student responses using 3 aspects, namely aspects of appearance, presentation of material, and aspects of benefits. After the design stage of the HOTS-Based Interactive E-module to Train Critical Thinking Skills of High School Students on Harmonic Vibration Material, the next step is the development stage.

At this stage of development, validation of the e-module developed by three expert judgments and revisions based on the results of expert validation is carried out, after obtaining the results of expert validation, a HOTS-based Interactive E-module product is obtained to train high school students' critical thinking skills on Harmonic Vibration material which is feasible at this stage to determine the feasibility of the e-module developed. This product validation test was carried out by 3 expert judgments, namely, two lecturers of Physics Education FKIP Bengkulu University, and one high school teacher N 01 Bengkulu City. The validation consists of several aspects, namely content aspects, presentation aspects, language aspects and media aspects as well as critical thinking aspects.

The initial product produced from this research is in accordance with the initial design / framework that has been made, including the cover page, preface, table of contents, material, summary, exercise questions, bibliography, glossary, and discussion of questions. In this activity, validation of the e-module is carried out. This stage is carried out to determine the validity of the e-module developed. The validity test for this product was carried out by 3 expert judgments consisting of 2 lecturers from Physics Education FKIP Bengkulu University and 1 high school teacher N 1 Bengkulu City. The results obtained from the validation that has been carried out are:

Table 1. Results of Content Aspect Validity Test by Expert Judgement

Validator	Score obtained	Maximum Score	Percentage	Category
Expert I	24	32	75%	Feasible
Expert II	32	32	100%	Very Feasible
Teacher	29	32	90,625%	Very Feasible
Average	28,33%	32	88,54%	Very Feasible

Based on the results of the content aspect validity test conducted by expert judgment I, II, and III, it is known that the content aspects in the e-module on harmonic vibration material that has been made are in the very good category with a percentage of 88% out of 100%. The percentage of 100% is the percentage of the maximum validity value.

Table 2 Results of Presentation Aspect Validity Test by Expert Judgement

Validator	Score obtained	Maximum Score	Percentage	Category
Ahli I	17	20	85 %	Very Feasible
Ahli II	20	20	100%	Very Feasible
Guru	17	20	85%	Very Feasible
Rata-Rata	18	20	90%	Very Feasible

Based on the validity test of the presentation aspect carried out by expert judgment I, expert II, and expert III, it is known that the presentation aspect of the e-module on the harmonic vibration material developed is in the very good category with a percentage of 90% out of 100%. The percentage of 100% is the ideal maximum percentage for validity assessment.

Table 3 Results of Validity Test of Language Aspects by Expert Judgement

Validator	Score obtained	Maximum Score	Percentage	Category
Expert I	16	20	80 %	Very Feasible
Expert II	20	20	100 %	Very Feasible
Teacher	17	20	85 %	Very Feasible
Average	17,7	20	88,3 %	Very Feasible

For the validity test of the language aspect carried out by expert judgment I, expert II, and expert III, it is known that the language aspect of the e-module using Flip Pdf Pro developed is in a very good category with a percentage of 88% out of 100%. The percentage of 100% is the ideal maximum percentage for assessment.

Table 4 Results of Media Aspect Validity Test by Expert Judgement

Validator	Score obtained	Maximum Score	Percentage	Category
Expert I	32	40	80%	Very Feasible
Expert II	36	40	90%	Very Feasible
Teacher	35	40	87,5%	Very Feasible
Average	34,3%	40	85,83%	Very Feasible

Based on the validity test of the media aspects carried out by expert judgment I, expert II, and expert III, it is known that the media aspects of the e-module using Flip PDF Professional developed are in the very good category with a percentage of 85% out of 100. The percentage of 100% is the ideal maximum percentage for validity assessment.

Table 5 Results of the Validity Test for the Training of Critical Thinking Skills Aspect

Validator	Score obtained	Maximum Score	Percentage	Category
Expert I	18	24	75 %	Feasible
Expert II	23	24	95,83 %	Very Feasible
Teacher	20	24	83,3 %	Very Feasible
Average	20,3	24	84,72 %	Very Feasible

Based on the validity test of critical thinking aspects carried out by expert judgment I, expert II, and expert III, it is known that the critical thinking aspects of the e-module using Flip PDF Professional developed are in a very good category with a percentage of 84.72% out of 100. The percentage of 100% is the ideal maximum percentage for validity assessment.

Disseminate

After obtaining the feasibility of the e-module, a limited trial of the HOTS-Based Interactive E-module to Train Critical Thinking Skills of High School Students on Harmonic Vibration Material was conducted in one class at SMAN 01 Bengkulu City with 35 students. This e-module can be accessed by students through electronic devices such as smartphones and computers, and as for the output of the e-module later, the link of this e-module is shared so that students can study this e-module again when they are at home. Furthermore, this e-module is accessed online through a website or link so that to do learning using this e-module must use an internet network.

The results of students' perceptions of e-modules are very good, students are very interested in learning to use them and are very enthusiastic about learning can be seen from the results of the questionnaire of students' perceptions, on the aspect of the presentation of e-modules using Flip PDF Professional on harmonic vibration material is in a very good category, namely with a percentage of 86%, for the aspect of the e-module display using Flip PDF Professional on the presentation of harmonic vibration material is in a very good category, namely with a percentage of 82%, and for the aspect of the usefulness of e-modules using Flip PDF Professional on harmonic vibration material is in a very good category as well, namely with a percentage of 84%.

Table 6 Results of the Learner Perception Questionnaire

Aspect	Score obtained	Maximum Score	Percentage	Category
View	969	1120	86,5 %	very good
Material Presentation	1268	1540	82,3%	very good
Benefits	709	840	84,4%	very good
Average	982	1166,6	84,4%	very good

This research is relevant to the research conducted (Marcelina et al., 2022) in his research entitled Development of E-Modules Assisted with Videoscribe Simulation to train students' critical thinking skills on the subject of parabolic motion states that the use of teaching materials in the learning process will produce a good response for students. In addition, it is also relevant to research (Puspita, Hidayat, and Wawan Kurniawan 2019) In his research entitled Development of Physics Electronic Modules Based on a Scientific Approach to Harmonic Vibration Material Using Kvisoft Flipbook Maker, he stated that the development and trial of electronic modules resulted in a physics electronic module based on a scientific approach to SMA / MA harmonic vibration material using Kvisoft Flipbook Maker which is valid and feasible to use.

In addition, it is also relevant to research conducted by (Oktaviana et al., 2020) entitled "Development of Electronic Learning Modules Assisted with PhET Simulation on the Subject of Simple Harmonic Motion in High School" the advantages of this study are the presentation of the contents of the module displayed in 3D so that it gives the impression of reading a book in physical form, equipped with PhET simulations so that students are able to understand concepts easily, the material and images presented are more complete and equipped with student worksheets and practice questions to train students' understanding.

When developing the product there are several obstacles. The obstacles faced when developing HOTS-based e-modules on harmonic vibration material are videos that are input into the e-module that cannot be played when published so that it can be replaced by uploading videos to YouTube so that it can only be done by adding a YouTube link that we have created ourselves. The advantages of the product are in line with (Lisa & Susilowibowo, 2016) e-modules as a companion material for student learning are very easy to obtain without having to spend a lot of money, so this eases the burden on students and becomes more enthusiastic in learning because there are interesting features in E-Modules. And also in the e-module there are several images, videos and e-modules are also interactive such as in the table of contents section students can go directly to the destination page by simply clicking on the desired page, and there are also several questions that can be answered by clicking on the selected answer and for the answer key from the exercise questions already contained in this e-module so that students can learn when using this e-module, and for LKPD in this e-module students can also be accessed by clicking on the menu in the LKPD section so that students can directly answer the results of the discussions they have had. So that by using this e-module students can learn anywhere.

D. Conclusion

Based on the research and development and discussion of the HOTS-Based Interactive E-module to Train Critical Thinking Skills of High School Students on Harmonic Vibration Material, the resulting e-module contains text, tables, images, formulas, learning videos that explain the teaching material and simulations, thus helping students understand the teaching material, in the e-module there is an interactive quiz that facilitates students to train their abilities. After students learn to use HOTS-based e-modules on harmonic

vibration material, data obtained shows that the feasibility of e-modules is in the very feasible category with an average score of 87.2%. Based on the results of students' perceptions of HOTS-based e-modules on harmonic vibration material, it is in the very good category, it is shown by the positive response from students with a percentage in the display aspect of 86.5%, the presentation aspect of the material is 82.3%, and in the aspect of usefulness the percentage is 84.4%, all aspects are in the very good category and the accumulative average value is 84.4%.

E. Acknowledgment

The success of this research is inseparable from the help of various parties, for that with all humility, the author would like to thank: Prof. Dr. Aprizal Mayub, M.Kom as the Main Supervisor and Mr. Dedy Hamdani, S.Si, M.Si as the Co-Supervisor. Thank you to all students, teachers, and staff of SMAN 4 Bengkulu City, SMAN 1 Bengkulu City, and SMAN 8 Bengkulu City who have given permission to conduct research at their schools.

References

- Arini, W., & Juliadi, F. (2018). Analisis Kemampuan Berpikir Kritis Pada Mata Pelajaran Fisika Untuk Pokok Bahasan Vektor Siswa Kelas X Sma Negeri 4 Lubuklinggau, Sumatera Selatan. *UAD Journal Management System*, 10(1), 1–11. <https://doi.org/10.12928/bfi-jifpa.v10i1.9485>
- Fausih, M., & Danang, T. (2015). Pengembangan Media E-Modul Mata Pelajaran Produktif Pokok Bahasan “Instalasi Jaringan Lan (Local Area Network)” Untuk Siswa Kelas Xi Jurusan Teknik Komputer Jaringan Di Smk Negeri 1 Labang Bangkalan Madura. *Jurnal UNESA*, 01(01), 1–9. [Google Scholar](https://doi.org/10.12928/bfi-jifpa.v10i1.9485)
- Hidayaturrohmah, R., Lesmono, A. D., & Prihandono, T. (2017). Pengembangan Bahan Ajar Interaktif Fisika Berwawasan SETS untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. In *Seminar Nasional Pendidikan Fisika 2017* (Vol. 2, Issue 1, pp. 1–9). [Google Scholar](https://doi.org/10.12928/bfi-jifpa.v10i1.9485)
- Ichsan, I. Z., Sigit, D. V., Miarsyah, M., Ali, A., Arif, W. P., & Prayitno, T. A. (2019). HOTS-AEP: Higher order thinking skills from elementary to master students in environmental learning. *European Journal of Educational Research*, 8(4), 935–942. <https://doi.org/10.12973/eu-jer.8.4.935>
- 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. <https://doi.org/10.30870/volt.v2i1.1478>
- Indah, P. (2020). Development of HOTS (High Order Thinking Skill) Oriented Learning Through Discovery Learning Model to Increase The Critical Thinking Skill of High School Students. *International Journal of Chemistry Education Research*, 4(April), 26–32. <https://doi.org/10.20885/ijcer.vol4.iss1.art4>
- Lisa, T., & Susilowibowo, J. (2016). PENGEMBANGAN BAHAN AJAR E-MODUL SEBAGAI PENDUKUNG PEMBELAJARAN KURIKULUM 2013 PADA MATERI AYAT JURNAL PENYESUAIAN PERUSAHAAN JASA SISWA KELAS X AKUNTANSI SMK NEGERI 1 SURABAYA. *Pengembangan Bahan Ajar EModul Sebagai Pendukung Pembelajaran Kurikulum 2013 Pada Materi Ayat Jurnal*, 1–9. [Google Scholar](https://doi.org/10.30870/volt.v2i1.1478)
- Marcelina, S., Medriati, R., & Putri, D. H. (2022). Pengembangan E-Modul Berbantuan Simulasi Videoscribe untuk melatih kemampuan berpikir kritis siswa pada pokok bahasan gerak parabola. 3, 122–127. <https://doi.org/10.33369/ajipf.1.2.122-127>
- Maryuliana, Subroto, I. M. I., & Haviana, S. F. C. (2016). Sistem Informasi Angket Pengukuran Skala Kebutuhan Materi Pembelajaran Tambahan Sebagai Pendukung Pengambilan Keputusan Di Sekolah Menengah Atas Menggunakan Skala Likert. *Jurnal Transistor Elektro Dan Informatika*, 1(2), 1–12. <https://doi.org/10.30659/ei.1.1.1-12>
- Miterianifa, M., Ashadi, A., Saputro, S., & Suciati, S. (2021). Higher Order Thinking Skills in the 21st Century: Critical Thinking. <https://doi.org/10.4108/eai.30-11-2020.2303766>
- Ni Kadek Ayu Suatini. (2019). Langkah-langkah Mengembangkan Kemampuan Berpikir Kritis Siswa. 21(1), 1–9. [Google Scholar](https://doi.org/10.33369/ajipf.1.2.122-127)
- Oktaviana, M., Putri, D. H., & Ridianto, E. (2020). PENGEMBANGAN MODUL ELEKTRONIK BERBANTUAN SIMULASI PhET PADA POKOK BAHASAN GERAK HARMONIK SEDERHANA DI SMA. *Jurnal Kumparan Fisika*, 3(2), 131–140. <https://doi.org/10.33369/jkf.3.2.131-140>
- Puspita, D. A., HIDAYAT, M., & Wawan Kurniawan. (2019). PENGEMBANGAN MODUL ELEKTRONIK FISIKA BERBASIS PENDEKATAN SAINTIFIK MATERI GETARAN HARMONIS

- MENGGUNAKAN KVISOFT FLIPBOOK MAKER. 12. [Google Scholar](#)
- Puspitasari, R., Hamdani, D., & Risdianto, E. (2020). Pengembangan E-Modul Berbasis Hots Berbantuan Flipbook Marker Sebagai Bahan Ajar Alternatif Siswa Sma. *Jurnal Kumparan Fisika*, 3(3), 247–254. <https://doi.org/10.33369/jkf.3.3.247-254>
- Saptono, A., Suparno, S., Wibowo, A., Ahman, E., Ismiyati, I., & Sukayugi, D. (2020). An analysis of higher-order thinking skills (HOTS) in the learning of economics. *International Journal of Learning, Teaching and Educational Research*, 19(4), 268–290. <https://doi.org/10.26803/ijlter.19.4.16>
- Sugiyono. (2014). *Metode Penelitian Kuantitatif, Kualitatif dan R & D*. Alfabeta.
- Susanto, E., & Retnawati, H. (2016). Perangkat pembelajaran matematika bercirikan PBL untuk mengembangkan HOTS siswa SMA. *Jurnal Riset Pendidikan Matematika*, 3(2), 189–197. <https://doi.org/10.21831/jrpm.v3i2.10631>
- Syafutri, E., & Pramudya, Y. (2019). PENGEMBANGAN E-MODUL FISIKA INTERAKTIF PADA MATERI FLUIDA DINAMIS MENGGUNAKAN PENDEKATAN SETS (*Science , Environment , Technology , Society*). *September*, 330–340. [Google Scholar](#)
- Yayuk, E., Deviana, T., & Sulistyani, N. (2019). KEMAMPUAN GURU DALAM IMPLEMENTASI PEMBELAJARAN DAN PENILAIAN HOTS PADA SISWA KELAS 4 SEKOLAH INDONESIA BANGKOK THAILAND. 5(November), 107–122. <https://doi.org/10.22219/jinop.v5i2.7106>
-

Copyright Holder

© Akbar Agustian, M., Mayub, A., & Hamdani, D.

First publication right :

FINGER: Jurnal Ilmiah Teknologi Pendidikan

This article is licensed under:

