

[Research Article]

## DEVELOPMENT OF WEBTOON-BASED PHYSICS E-MODULES IN WORK AND ENERGY TOPICS ON STUDENTS' CRITICAL THINKING SKILLS

*Kristina Iwung<sup>1</sup> and Andi Ruhendi Nugraha<sup>2</sup>*

<sup>1</sup>*Department of Physics Education, Faculty of Science and Technology, Universitas PGRI Kanjuruhan, Malang, Indonesia*

<sup>2</sup>*Department of Physics, Faculty of Mathematics, Informatics and Natural Sciences, Universität Hamburg, Hamburg, Germany*  
E-mail: [kristinaiwung@gmail.com](mailto:kristinaiwung@gmail.com)

DOI: <https://doi.org/10.15575/jotalp.v7i1.14286>

Received: 28 September 2021 ; Accepted: 26 February 2022 ; Published: 28 February 2022

### ABSTRACT

This study aims to make a webtoon-based e-module on work and energy topics which tested for feasibility, effectiveness and implementation to improve students' critical thinking skills. This is a research and development using the ADDIE development model, namely: 1) initial needs analysis; 2) developing media design and research instruments; 3) e-module development using Gacha Life and Pinterest applications; 4) a small-scale limited test on 22 students; 5) evaluation by users and the critical thinking index used. The critical thinking index used is: analysis, interpretation, inference and evaluation. The instruments used in this study were media validation questionnaires, material validation questionnaires, and student response questionnaires. The results of the description of input from media experts and webtoon-based e-module material experts deserve to be used as a new alternative for physics learning tools. Feasibility media has score of 3.28 in the "very good" category, while material experts obtained score of 3.1 in the "good" category. The small-scale implementation increase students' critical thinking skills in medium category. This webtoon-based physics e-module can be used as an alternative source in physics learning so that learning becomes more interesting.

Keywords: Learning Media, E-modules, Effort and Energy, Critical Thinking Skills

**How to cite:** Iwung, K. & Nugraha, A. R. (2022) Development of webtoon-based physics e-modules in work and energy topics on students' critical thinking skills, *Journal of Teaching and Learning Physics* 7 (1), 62-71. DOI: <https://doi.org/10.15575/jotalp.v7i1.14286>





## 1. INTRODUCTION

The changing times have led humans to the 4.0 revolution era, which has given birth to a fundamental transformation of human life (Wakhidah & Sunismi, 2020; Malik, 2019). These changes can be seen from the way human activities in the world of education and work. Ideal learning according to the development of the industrial revolution 4.0 era in the 21st century which is also known as 21st learning, where learning is a means to foster a generation that is ready for the 21st century where learning involves a lot of technological skills and digital literacy, the use of gadgets and other technology-based tools (Sajidan, 2019)

21st century learning requires more creative assessment facilities, one of which is a change in learning facilities. Learning materials used must be more interesting, creative, fun. Learning facilities used in schools are generally only in the form of worksheets and textbooks which tend to be less pleasant so that as a result most students are too lazy to open or read them. Structured learning facilities are structured using language that is easily understood by students such as their level of knowledge and age with at least assistance or support from the teacher, so that they can learn (Setyoati & Subali, 2011).

Based on the results of the initial needs questionnaire analysis in one of the schools it was found that the learning facilities used were only teacher handbooks and student worksheets, even the existing reading park was very limited for reading books as learning tools, especially Physics subjects. Based on the problems above, it is necessary to have a learning facility that is able to facilitate students to study. Integrating technology in education, especially using online, brings new changes and provides opportunities for high interpretation and learning outcomes (Sujanem et al, 2009; Haryadi & Nurmala, 2021). One of the learning tools that meet the criteria for online is e-module. E-module is a framework for delivering an independent assessment vehicle that is structured coherently into the learning

components provided in the electronic edition, where a study activity in it connects link as a liaison that fosters students so that they are more active in using designs to enrich the learning experience (Zulfahrin, 2019). The use of e-modules can increase student interest because it presents lessons that are more attractive (Rusdin, Widodo, & Maruto, 2020).

In general, e-module learning media are commonly used, so this research combines e-modules with webtoons. Webtoon is an application found on smartphones both Android and IOS. This webtoon can be used to improve students' skills because the narration is provided with easy-to-understand words, uses virtual reality (Rossana et al, 2019) and the cost of producing this is quite economical because it is published online rather than the actual production of textbooks (Setiawan, 2020; Kurniawan & Hidayah, 2021). Device Webtoon facilitate learning between educators and students, because they do not really need books, activities are carried out using connected devices or smartphones and laptops (Suciati dkk. 2019). Teachers can use webtoons as a tool in the learning process to create a new atmosphere by reading digital comics on the web, which can be used as additional information and knowledge, supplements based on comic genres and what is discussed in comics. In addition, according to Suciati & Sumarti (2019) in their research, they explain that webtoons should be used to increase student literacy, because the narrative is displayed. in easy-to-understand language, like regular online comics, and pronounced from top to bottom.

One of the demands of the 2013 curriculum is that every student must have critical thinking skills. Critical thinking is a way of determining what is worth believing and doing (Facione, 2016). Through the development of critical thinking skills, students are guided to respond to situations, pose problems, form assumptions, observe and mobilize data, and convey information on the development of critical thinking. The importance of critical thinking skills

in helping students develop skills, train concentration, and focus on problems and improve students' analytical thinking skills (Sari et al, 2019).

In this study, the materials used in the development of e-modules are work and energy. According to Santi & Agus (2018), the subject of physics in secondary schools often contains abstract concepts. Previously, research on work and energy learning strategies had been carried out for students, but there were still many misunderstandings among students about work and strength problems (Neumann dkk, 2013). In addition to misunderstandings, students' understanding is very chaotic so that if they are used to solving increasingly complex questions, students will have difficulty. Therefore, understanding related to work and energy materials must be considered so that students can easily get additional lessons related to work and energy (Handayani, 2018). Thus, the novelty of this study is developing an alternative learning sources using webtoon media. This study aims to create a webtoon on work and energy materials regarding students' critical thinking skills that have been tested for feasibility, effectiveness and implementation.

## 2. METHOD

This observation is considered in the exploration and expansion group using *Research and Development* (R & D). According to Riska dkk (2021), exploration and expansion is an inspection system developed to create legal and practical products. The exploration and expansion process involves expanding creations or enhancing existing creations. The development system used in the observation is ADDIE. This model includes 5 stages of expansion, namely analysis, design, development, implementation, evaluation.

### 2.1 Analysis

In the analysis stage the researcher conducts an initial needs analysis by giving questionnaires to

students including student responses regarding the use of learning facilities and the frequency with which students seek *online*. After knowing the results of the initial needs analysis, the researcher made a concept about the product, determining the material and indicators used.

### 2.2 Design

At the design stage, it is adjusted to the results of the analysis stage. The device used in the design is Microsoft Word to combine materials and webtoon icons that will be used in e-modules, the Gacha Life and website to create icons and remove background websites to edit icons. The product is made in the form of an electronic module with the following formats: portrait, font century gothic, comic sans MS, times new roman and calibri.

### 2.3 Devolepment

At the stage of compiling the ready e-module, it will be validated by material experts and media experts before being implemented. Validation intends to find out whether the product used is valid for the material presented and the media designed.

### 2.4 Implementation

After the product is declared suitable for use, the e-module will be implemented. The e-module will be implemented in real terms for students of class X MIPA at one of the SMAK in Malang City.

### 2.5 Evalutation

Evaluation is given to find out whether the e-module used has a good influence on students. At the evaluation stage to explore student responses and subject teacher responses, researchers distributed student response questionnaire sheets and subject teacher response sheets.

The feasibility of the product will be assessed from the validation results of material experts and media experts. The validation that was tested

was the feasibility of the content, language and completeness of the material. Learning media validation instruments can be seen in Table 1 and learning material validation instruments can be seen in Table 2.

**Table 1.** Learning Media Expert Validation Instruments

No	Learning Assessment Perspectives
<b>E-module Quality</b>	
1	Ease of accessing E-module
2	Quality images in E-modules
3	Quality of text in E-modules
4	Display design of E-modules
<b>Instructional Quality</b>	
5	Support for independent learning activities
6	Makes it easier to understand the material Effort and Energy is presented
<b>Language Quality</b>	
7	Use of language in E-modules

**Table 2.** Material Expert Validation Instruments Learning

No	Assessment Perspective
<b>E-module Content</b>	
1	Similarity of subject with critical thinking indicators
2	Achieving study objectives
3	Truth of subject structure
<b>Language</b>	
4	Communicative language
5	Sentences used
6	Correctness of notation
<b>Critical Thinking Indicator</b>	
7	Can improve interpretation skills through pictures illustrations in E-module
8	Can improve Camp iran analysis through discussion questions presented
9	Can improve evaluation skills through practice questions in E-module
10	Can improve inference skills by presenting simpler material

Validity analysis is carried out using Likert comparisons with the following conditions: 4 =

super good, 3 = good, 2 = not slick, 1 = super not slick. Points obtained from the whole will be calculated as a percentage. Based on the average percentage of the total score, the feasibility of the e-module can be used by referring to the criteria contained in Table 3 (Khamzawi, 2015).

**Table 3.** Validity category of product eligibility

No	Value	Criteria
1	$80\% < x \leq 100\%$	Very True
2	$60\% < x \leq 80\%$	True
3	$40\% < x \leq 20\%$	Less true
4	$20\% < x \leq 40\%$	Fairly True
5	$0\% < x \leq 20\%$	Not true

The effectiveness of the product is assessed on the *pretest* and *posttest* students. The purpose of giving *pretest* and *posttest* is to find students' critical thinking skills before and after using the e-module. Critical thinking indicators used are interpretation, analysis, evaluation and inference. The description of each indicator can be seen in Table 4 (Facione, 2016)

**Table 4.** Critical thinking index

Critical Thinking Index	Deskripsi
Interpretation	The ability to understand, know, and express the meaning of a problem and experience.
Analysis	The ability to recognize and summarize correlations between statements, concepts, questions, images, or other forms.
Evaluation	Ability to judge statements fairly whether they can access correlations between explanations, problems and concepts and representations.
Inference	The ability to recognize and get the elements needed to draw conclusions.
Explanation	Ability to define logic and assign elements based on the results obtained.
Self Regulation	Ability to monitor one's cognitive function, factors used in problem solving.

Scores *Pretest* and *post-test* were analyzed using the normalized gain (N-gain) in equation 1.

$$\langle g \rangle = \frac{\langle s_f \rangle - \langle s_i \rangle}{100 - \langle s_i \rangle} \times 100\% \quad (1)$$

where  $\langle g \rangle$  is normalized gain (N-gain);  $s_f$  is posttest and  $s_i$  is pretest.

The results of the N-gain score are divided into three groups as shown in Table 5 (Setiyani, 2017).

**Table 5.** Normalized Gain Standard

Nilai N-gain	Standard
$\langle g \rangle \geq 0,7$	High
$0,3 \leq \langle g \rangle < 0,7$	Medium
$0,00 < \langle g \rangle < 0,3$	Low

Product implementation is assessed from the results of the analysis of student response questionnaires and subject teacher response questionnaires after using e-modules and seen from the increase in critical thinking indicators used in e-modules. The results obtained from the student response questionnaire and the teacher's response were calculated the percentage and categorized based on the criteria in Table 6.

**Table 6.** Standard student response

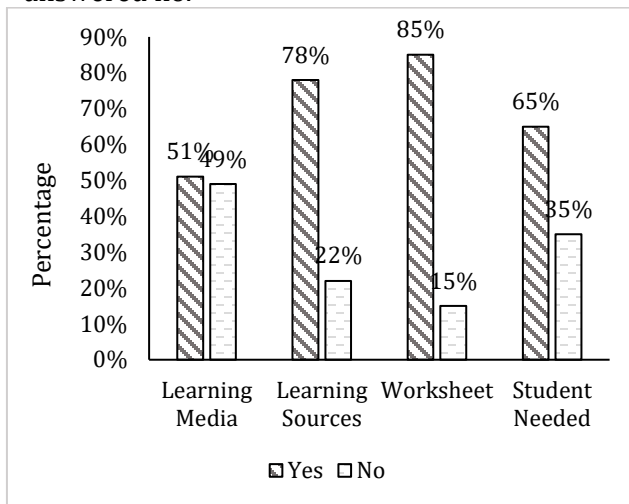
Percentage	Criteria
$75\% \leq R \leq 100\%$	Very Positive
$50\% \leq R < 75\%$	Positive
$25\% \leq R < 50\%$	Less Positive
$0\% \leq R < 25\%$	Negative

### 3. RESULT AND DISCUSSION

Based on the results of the description of initial needs in one SMAK in Malang City, schools have facilities that support the implementation of e-modules. The results of the needs analysis can be seen in Figure 1.

Based on the results of the needs analysis on the impressions of students regarding the use of learning facilities, it was found that students who wanted to use learning facilities other than those provided by the subject teacher were more

students who answered yes than students who answered no.



**Figure 1.** Percentage of Preliminary Needs Analysis

The feasibility of the e-module is seen from the validation results by the material jury and media jury. The validator is a lecturer in the department of physics education at the University of PGRI Kanjuruhan Malang who is an expert and experienced in media development. Media experts and material experts will be asked for their opinions on the instruments to be given. Expert opinion about the instruments that have been compiled can be in the form of a decision whether the instrument can be used, can be used with repairs or cannot be used at all (Nurzaman et al, 2021). The validation results from media experts can be seen in Table 7.

**Table 7.** Media Expert Validation Results

No	Learning Assessment Perspective	Score
<b>E-module Quality</b>		
1	Ease of accessing E-module	4
2	Image quality in E-modules	4
3	Text quality in E-modules	4
4	E-module display design	4
<b>Instructional Quality</b>		
5	Support for independent learning activities	1
6	easy to understand the Business and Energy material presented	2
<b>Language Quality</b>		
7	Use of language in	4

E-module	
Total Score	23

Based on table 7 which shows the results of obtaining media expert validation scores , the average value is 3.28 and is included in the very good category and the percentage of presentation feasibility is 82% including in the valid category, so that from the feasibility of presenting a *webtoon* on business and energy materials it is adequate to use. Revisions from media experts suggest pictures that show examples of the application of the material as much as possible using real or close images so that they are easy for students to study and reduce student misconceptions. This is in accordance with the opinion of Sajidan (2016) which states that images can support and clarify the contents of the document in a way that makes it interesting and reduces boredom for readers.

In addition to validating media experts, validation is also carried out to material experts. The validation results from material experts can be seen in table 8.

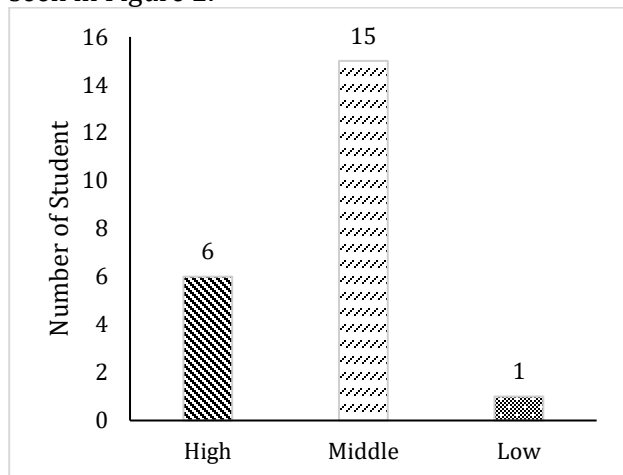
**Table 8.** Material Expert Validation Results

No	Learning Assessment Perspective	Score
<b>E-module Content</b>		
1	Similarity of subject with critical thinking indicators	2
2	Achieving study objectives	3
3	Truth of subject structure	3
<b>Language</b>		
4	Communicative language	4
5	Sentences used	3
6	Correctness of notation	4
<b>Critical Thinking Indicator</b>		
7	Can improve interpretation skills through pictures illustrations in E-module	2
8	Can improve Camp iran analysis through discussion questions presented	3
9	Can improve evaluation skills through practice questions in E-module	4
10	Can improve inference skills by presenting simpler material	2
Total Score		30

Based on the table of material expert assessment results, an average value of 3.1 is obtained so that it is included in the good category and the percentage of 77% is in the valid category. Judging from the average score and percentage, in terms of the feasibility of presenting material on an electronic *webtoon* with the main theme of business and energy, it is feasible to use it. An assessment is carried out by these experts so that the products developed achieve the desired goals (Ipin, 2018; Yuliantaningrum & Sunarti 2020). Comments posted by validators as data advice for researchers need improvement. In line with the opinion of Herawati & Muhtadi (2018) that of all aspects that have been assessed by validators, this research instrument is considered suitable for use with improvements, components that must be corrected before being used. From the results of the validation analysis by the validator, the developed e-module meets the authentic criteria so that the *webtoon is suitable* for use in learning.

The effectiveness of webtoon-based e-modules, Solihudin JH (2018) explained the effectiveness of the e-module obtained from the data of the student's academic test results. Students' critical thinking skills were measured using essay questions. The questions are developed based on the indicators of critical thinking skills developed according to Facione (2016). There are four indicators, namely interpretation, analysis, evaluation and inference. *Pretest* is given before learning is done while *posttest* is given after students learn business and energy lessons using *webtoon* on students' critical thinking skills with the same question indicator. The development of students' critical thinking skills is summed using the N-gain calculation. Based on the results of data analysis for class X Mathematics and Natural Sciences in one of the cities in Malang, Kepanjen, which has been calculated using N-gain, it is obtained that the number of N-gains for increasing critical thinking skills from 22 students who are used as small-scale test subjects is 0.59, including on a medium scale. The results of

improving students' critical thinking skills can be seen in Figure 2.



**Figure 2.** Results of Increasing Students' Critical Thinking Skills

Figure 2 shows that students who have the ability to answer questions with the highest score are 6 people who answer with a moderate score are 15 people and those who answer with a low score score are 1 person. From the results of the analysis, it is known that the development of *webtoon* on students' critical thinking skills in business and energy lessons has increased. In line with the idea of Alperi (2015) which states that learning using learning facilities gives birth to students who are more enthusiastic and influenced, so that student learning outcomes also increase.

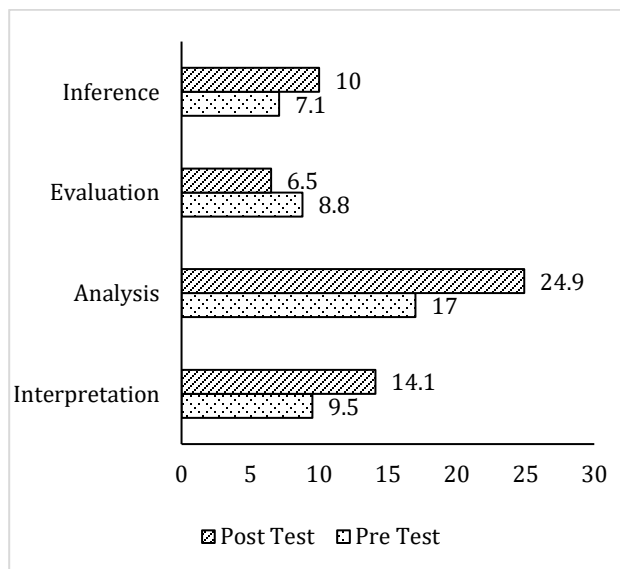
Kurnia (2019) also revealed that if the media is well designed, it will provide greater capacity for students and will be effective in their use. And in Diana & Sukestiyarno (2019) e-module-based self-reliance learning effectively adds students' critical thinking skills. Based on the results of Ngain's translation, it can be seen that the criteria for the effectiveness of the e-physics module with a *webtoon* in the business and energy lessons on students' critical thinking skills are met. This is supported by the research of Kusumasari et al (2021) which states that the *webcomic physics webtoon* can be used as an alternative in learning because it is more interesting and can lead students to absorb material more quickly.

The implementation of the e-module with a *webtoon* can be seen in the student response questionnaires and the responses of subject teachers. Questionnaire or questionnaire is a data collection system through the rules of presenting a series of affirmations or written notices to respondents to be answered synchronously through user interest (Akbar et al, 2021; Kohnke, & Moorhouse, 2020). The results of the elaboration of the student response questionnaire regarding the *webtoon* the average total score was 3.70 in the very good category and the percentage of 92% in the very positive criteria.-based e-modules *webtoon* that are presented are very helpful for students towards learning.-based e-module learning facilities *webtoon* in business and energy lessons about the thinking skills of students from the perspective of content feasibility and language feasibility is very good.

On the feasibility of the content of the aspects assessed, the problems presented, the scope of the material, examples of questions and practice questions, while the feasibility of the language aspects that are assessed are the language in the presentation of the material and the language used in the questions. From the analysis results, the average total score is 4.0, in the very good category and the percentage is 100%, which means the learning media used is very good to use because it helps educators in delivering material with different alternatives. The results of the analysis are in line with the opinion of Herawati & Muhtadi (2018) which states that to accommodate educators, to make students more active and independent, learning media in the form of electronic modules (e-modules) can be used.

The implementation of the e-module is also seen from the increase in critical thinking skills on the four indicators used.data on the increase in students' critical thinking skills can be seen in Figure 3.





**Figure 3.** Average Increase in Students' Critical Thinking

Skills Interpretive proficiency in e-modules for developing students' interpretation skills is by displaying replicas of questions that are often used in daily activities. Analytical skills in e-modules to improve students' analytical skills at the end of each *sub* lesson are presented with discussion questions. Evaluation skills in e-modules to improve these skills are by providing practice questions at the end of the material. Inference skills in e-modules to improve students' inference skills, namely by presenting the material in a simpler way so that it helps students in the material they are learning.

Based on the results of the analysis of Figure 2, it can be seen that from the four indicators used, the interpretation indicator has the highest increase and the evaluation indicator has the lowest increase. This situation shows that the skills of students to master questions that intersect with everyday experience are increasingly easy to understand and the presentation of examples of material presented in e-modules is able to ease students in interpreting the material presented. Analysis indicators, lack of analytical skills in students because students are often given questions that only contain numbers and figures, in the e-module discussion questions are only

displayed on two *sub* materials. Evaluation indicators, lack of improvement in student proficiency in evaluation skills because students have difficulty applying the materials and designs they know to solve a problem and in the e-module practice questions are only shown at the end of the material. Inference indicators lack students' inference skills because they are able to draw conclusions from the questions asked, but are not able to provide an explanation of concepts that support these conclusions and in e-module material presentation on *sub*- potential energy and kinetic energy confusion in determining the formula used in working on the problem.

#### 4. CONCLUSION

Based on the results and assessment, it was decided that the webtoon-based physics e-module on the material of effort and energy on students' critical thinking skills was declared valid to be used and able to increase students' critical thinking skills. This webtoon-based physics e-module can be used as an alternative source in physics learning so that learning becomes more interesting.

#### 5. REFERENCES

Akbar, T., Sari, Z., Okilanda, A., & Gemael, Q. (2021). The effect of fartlek training on the increase in vo2max of tapak suci pencak silat athletes. *Jurnal Patriot*, **3**(1), 71-81. <https://doi.org/10.24036/patriot.v3i1.767>

Alperi, M. (2019). Peran bahan ajar digital sigil dalam mempersiapkan kemandirian belajar peserta didik. *Jurnal Teknodik*, **23**(2) 99-110. <https://doi.org/10.32550/teknodik.v0i1.479>

Nurzaman, R. F. R., Yuningsih, E. K., Agustina, R. D., Zakwandi, R., Dirgantara, Y., & Kuntadi, D. (2021). An optical instrument worksheet in physics class. *Journal of Physics: Conference Series* **1869** (1). 012169. <https://doi.org/10.1088/1742-6596/1869/1/012169>

Diana, N., & Sukestiyarno, S. (2019). Analisis

- kemampuan berpikir kritis siswa pada pembelajaran mandiri berbasis e-modul. *Prosiding Seminar Nasional Pascasarjana (PROSNAMPAS)* **2**(1), 203-206.
- Handayani, A. (2018). Mengidentifikasi kesulitan-kesulitan yang dihadapi siswa SMA pada materi usaha-energi. *Momentum: Physics Education Journal*, **2**(1), 15-20. <https://doi.org/10.21067/mpej.v2i1.2370>
- Haryadi, R., & Nurmala, R. (2021). Pengembangan Bahan Ajar Fisika Kontekstual dalam Meningkatkan Motivasi Belajar Siswa. *SPEKTRA: Jurnal Kajian Pendidikan Sains*, **7**(1), 32-39.
- Herawati, N. S., & Muhtadi, A. (2018). Pengembangan modul elektronik (e-modul) interaktif dalam mata pelajaran kimia kelas XI SMA. *Jurnal Inovasi Teknologi Pendidikan*, **5**(2), 180–191. <https://doi.org/10.21831/jitp.v5i2.15424>
- Ipin, A. (2018). Pengembangan Soal-Soal Pilihan Ganda untuk Mengukur Kemampuan Berpikir Kritis Siswa pada Konsep Sistem Regulasi Manusia untuk Jenjang SMA. *Mangifera Edu*, **3**(1), 26-39. <https://doi.org/10.31943/mangiferaedu.v3i1.10>
- Kohnke, L., & Moorhouse, B. L. (2020). Facilitating synchronous online language learning through Zoom. *Relc Journal*, 1-6. <https://doi.org/10.1177%2F0033688220937235>
- Kurnia, Y. P., Sumarti, S. S., & Utomo, U. (2020). Implementation of problem based learning assisted with science comic books to improve critical thinking skill of elementary students. *Journal of Primary Education*, **9**(2), 186-192. <https://doi.org/10.15294/jpe.v9i2.27799>
- Kurniawan, R. D., & Hidayah, R. (2021). Validity of kimi kimo adventure game based on android as learning media in chemical bonds. In *International Joint Conference on Science and Engineering 2021 (IJCSE 2021)* 247-253. Atlantis Press.
- Kusumasari, W., Darmadi, I. W., & Saehana, S. (2021). Pengembangan media pembelajaran webcomic fisika webtoon untuk siswa SMP pada pokok bahasan hukum Newton. *JPFT (Jurnal Pendidikan Fisika Tadulako Online)*, **9**(1), 50-56.
- Malik, A. (2019). Creating competitive advantage through source basic capital strategic humanity in the industrial age 4.0. *International Research Journal of Advanced Engineering and Science*, **4**(1), 209-215.
- Chusni, M. M., Saputro, S., Suranto, S., & Rahardjo, S. B. (2020). Review of critical thinking skill in indonesia: Preparation of the 21st century learner. *Journal of Critical Reviews*, **7**(9), 1230-35. <http://dx.doi.org/10.31838/jcr.07.09.223>
- Muslimah, D. N. (2019). *Pengembangan E-Modul Berbasis Discovery Learning Untuk Meningkatkan Hasil Belajar Siswa Di SMKN 4 Kendal Dalam Kompetensi Dasar Kopling Dan Transmisi Manual*. Tesis, Fakultas Teknik: Universitas Negeri Semarang.
- Rossana, L., Siswandari, S., & Sudiyanto, S (2019). Komik digital berbasis pbl sebagai upaya meningkatkan motivasi dan keterampilan berpikir kritis: sebuah kajian literatur. *Seminar Nasional Pendidikan Pengembangan Kualitas Pembelajaran Era Generasi Milenial 2019*, 28–35. Semarang. Universitas Muhammadiyah Surakarta.
- Rusdin, M. E., Widodo, W., & Maruto, G. (2020). Implementation cooperative learning type stad assisted edmodo in improving students' critical thinking skills. *Indonesian Review of Physics (IRiP)*, **3**(1), 30-34. <https://doi.org/10.12928/irip.v3i1.1766>
- Sajidan. (2016). Mengembangkan modul biologi berbasis discovery learning (part of inquiry spectrum learning-wenning) pada materi bioteknologi kelas xii ipa di SMA Negeri 1 Magelang tahun ajaran 2014/2015. *Jurnal Inkuiri*, **5**(3), 144–154. <https://doi.org/10.20961/inkuiri.v5i3.9460>
- Santi, N. W., Suyatna, A., & Suyanto, E. (2018). Pengembangan buku elektronik inti atom sebagai bahan ajar mandiri untuk menumbuhkan kemampuan berpikir kritis siswa. *Jurnal Pembelajaran Fisika*, **6**(2). 134-145.

- Setiawan, R. (2020). Rancang Bangun Media Pembelajaran Berbasis Android Tanpa Coding Semudah Menyusun Puzzle. *Jurnal Sistem Informasi dan Sains Teknologi*, *2*(2). <https://doi.org/10.31326/sistek.v2i2.729>
- Solihudin JH, T. (2018). Pengembangan e-modul berbasis web terhadap peningkatan pencapaian kompetensi pengetahuan fisika pada materi listrik statis dan dinamis SMA. *WaPfi (Wahana Pendidikan Fisika)*, *3*(2), 51. <https://doi.org/10.17509/wapfi.v3i2.13731>
- Sari, I. P., Mustikasari, V. R., & Pratiwi, N. (2019). Pengintegrasian penilaian formatif dalam pembelajaran IPA berbasis saintifik terhadap pemahaman konsep peserta didik. *JIPVA (Jurnal Pendidikan IPA Veteran)*, *3*(1), 52-62. <https://doi.org/10.31331/jipva.v3i1.778>
- Sujanem, R., Suwindra, I. N. P., & Tika, I. K. T. (2009). Pengembangan modul fisika kontekstual interaktif berbasis web terhadap siswa kelas 1 SMA. *Jurnal Pendidikan Dan Pengajaran*, *42*(2), 97-104. <http://dx.doi.org/10.23887/jppundiksha.v42i2%20Jul.1743>
- UZ, L. Z. (2019). *Pengembangan E-Modul Kimia Berbasis Problem Based Learning (PBL) Untuk Meningkatkan Pemahaman Konsep Peserta Didik Program Studi Pengembangan Kurikulum*, Tesis, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Semarang.
- Riska, N., R. & Trisna. S. (2021). Pengembangan modul fisika berorientasi inquiry untuk peserta didik. *Journal of Teaching and Learning Physics* *6*(1), 31-38. <https://doi.org/10.15575/jotalp.v6i1.10620>
- Wakhidah, L. N., Sunismi, S., & Alifiani, A. (2020). Pengembangan bahan ajar berbasis literasi digital dan kompetensi abad XXI pada materi barisan kelas XI. *Jurnal Penelitian, Pendidikan, dan Pembelajaran*, *15*(33). 1-11.
- Yuliantaningrum, L., & Sunarti, T. (2020). Pengembangan instrumen soal hots untuk mengukur keterampilan berpikir kritis, berpikir kreatif, dan pemecahan masalah materi gerak lurus pada peserta didik SMA. *Inovasi Pendidikan Fisika*, *9*(2). <https://doi.org/10.26740/ipf.v9n2.p%25p>