Development of Application-based Interactive Science E-Modules PocketBook to Improve the Digital Literacy and Creative Thinking of Middle School Students

Fiky Ahmad Kanzul Fikri Pratama, Sri Wahyuni[*], Pramudya Dwi Aristya Putra
Master of Science Education, Postgraduate, Universitas Jember, Indonesia.
*Corresponding Author. Email: sriwahyuni.fkip@unej.ac.id

Abstract: This research aims to develop an application-based interactive Science E-Module PocketBook to improve the digital literacy and creative thinking of junior high school students. This research method used research and development with a 4D model (Define, Design, Develop, and Disseminate). Validation of the E-Module was carried out at the Jember University Master of Science Education campus while the validity test, practicality test, and effectiveness test of the application-based interactive Science E-Module PocketBook was carried out at SMPN 10 Jember and SMPN 12 Jember. The subjects in this development were class VIII even semester students. Results This research showed that the average validity score obtained is 86% by expert validators. The percentage of response results from the limited scale and class scale tests at SMPN 10 Jember were respectively 85.1% and 86.6%, each score can be categorized as very valid. Application-based interactive science e-module PocketBook It not only contains material but there are also assignments to improve students' digital literacy and creative thinking. Application-based interactive science e-module PocketBook the theme of vibrations and waves has also been distributed to two classes at SMPN 12 Jember with student response scores of 81.9% and 85.3% respectively.

How to Cite: Pratama, F., Wahyuni, S., & Putra, P. (2024). Development of Application-based Interactive Science E-Modules PocketBook to Improve the Digital Literacy and Creative Thinking of Middle School Students. *Jurnal Paedagogy, 11*(3), 602-611. doi:https://doi.org/10.33394/jp.v11i3.11852

Introduction

Science learning in the current digital era influences the learning process in the classroom, such as how to utilize digital literacy in learning and teachers must understand how to manage this dynamic change (Yustika and Iswati 2020). Digital literacy is a literacy concept that focuses on the use of technology in the digital era (Tohara et al. 2021). Digital literacy is very necessary for all aspects of life, including in the field of education (Voronin, Saienko, and Tolchieva 2020). The fact that digital literacy is multimedia access makes literacy skills via digital channels an important need, especially in the world of education.

Digital literacy via the internet makes literacy develop from just accessing information to finding, understanding, utilizing, evaluating, and developing various digital information to have a positive impact, especially in the educational aspect (Ramadhan, Sukma, and Indriyani 2019). Digital literacy contains three dimensions, namely Technical, Cognitive, and Social (Arslantas and Gul 2022). These digital literacy dimensions can be utilized by teachers when conducting learning using digital literacy with students and these digital literacy dimensions must not only be mastered by teachers but must also be mastered by students.

The 21st-century education system is required to improve the quality of students so they can compete globally. The independent curriculum demands learning that includes 21st-century skills, including the 4Cs (Critical thinking, Collaborative, Communicative, and

Creative) (Hikmaturrosyidah and Rachmadiarti 2022). If students can think creatively, then students will produce varied ideas and from these varied ideas, students can choose the most appropriate solution to solving a problem (Syahrin et al. 2019). So, in science learning, creative thinking is needed so that students not only get information related to the material but also increase their creativity.

Facts on the ground show that teachers have not utilized digital literacy in science learning even though in the school environment students already have adequate facilities, namely smartphones. The conditions for science learning in schools such as these problems should be addressed immediately, especially by teachers. Utilizing digital literacy in the context of science learning can not only increase literacy but can also increase students' creative thinking. Students' digital literacy and creative thinking can be optimized, one of which is by developing learning media that can stimulate creative thinking. E-modules are learning media that can be a solution related to efforts to increase digital literacy and creative thinking. It is different compared to existing modules which are usually presented to students in a hard form hardcopy, the e-module that researchers will develop is designed in an electronic format so that it can be used on various devices such as cellphones (Wulandari, Yogica, and Darussyamsu 2021).

Research related to the development of E-Modules in science learning is research from Syahiddah et al (2021) found that the development of a Science E-Module on the Sound theme was categorized as very suitable for implementation with a validity percentage of 98.6% and was categorized as very valid and also received very appropriate responses from students. Research from Afwina et al (2021) concluded that the development of the Science Module on the Optical Equipment theme was very valid with a validity level of 92.5% and showed that the Module was by the module effectiveness criteria. Saprudin *et al* (2022) stated that the Interactive E-Module with the theme Vibrations and Waves for Science Learning is effective for optimizing students' mastery of concepts and with a variety of media menus it can produce E-Modules that are more interesting and effective for students. The difference in research carried out by the author compared to previous authors is that the author developed an Application-based Interactive Science E-Module PocketBook Vibrations and Waves theme to improve digital literacy and creative thinking of junior high school students.

Interactive e-modules are displayed using the application PocketBook. PocketBook is Android/IOS software that can display e-modules practically. PocketBook is also the right solution because e-modules contain material, images, and videos that can be displayed easily (Wiyono, 2023). The urgency of this research is the unavailability of application-based interactive E-Modules PocketBook which can increase digital literacy and improve creative thinking. This research aims to develop an application-based interactive Science E-Module PocketBook to improve the digital literacy and creative thinking of junior high school students.

Research Method

This research method used research and development with a 4D model (Define, Design, Develop, and Disseminate) (Thiagarajan et al. 1974). This research was carried out at SMPN 10 Jember and SMPN 12 Jember. Validation of the E-Module was carried out at the Jember University Master of Science Education campus while the validity test, practicality test, and effectiveness test of the application-based interactive Science E-Module *PocketBook* was carried out at SMPN 10 Jember and SMPN 12 Jember. The subjects in this development were class VIII even semester students.

The Define is the initial stage for determining the needs faced in science learning. Analysis of teacher needs and analysis of student needs will be carried out at stage Define. The second stage is Design for determining an effective and efficient way to develop an E-Module. Things that need to be done at the stage Design namely Test Selection, Media Selection, Format Selection, and Initial Design. The third stage is Development carried out in three stages, namely Validation, limited scale trials, and class scale trials. Validation will be carried out by asking for considerations from expert validators and user validators. The expert validators consisted of two validators, namely two master lecturers in science education, FKIP, Jember University. The practitioner validators consisted of two science teachers in class VIII of junior high school. The technique used in Validation data analysis is adapting the percentage calculation technique and description technique formulated by Akbar (2016):

$$V_{ak} = \frac{T_{se}}{T_{sk}} \times 100\%$$

Information,

V_{ak} : Expert validation (percentage value);

T_{se} : Total empirical score;

T_{sk} : Maximum total score.

The eligibility criteria for the validation results are shown in the table below,

Table 1. Validation Criteria

Percentage (%)	Category
85,01-100,00	Very valid (feasible to implement without improvements)
70,01-85,00	Valid (worth implementing with minor improvements)
50,01-70,00	Invalid (recommended not to be implemented because it needs major improvements)
20,00-50,00	Invalid (cannot be applied)

The limited scale student response aims to find out that the interactive E-module is valid and suitable for use before being tested on a class scale. Limited scale student responses using 10 class VIII students at SMPN 10 Jember. Class scale student responses used 30 class VIII students at SMPN 10 Jember. The technique used in data analysis of student responses to Digital Literacy is adapting the percentage calculation technique and description technique formulated by Sugiono (2019):

$$V_{au} = \frac{T_{se}}{T_{sk}} \times 100\%$$

Information,

V_{au} = Audience validation (percentage value);

T_{se} = Total empirical score;

T_{sk} = Maximum total score.

The criteria obtained through student responses are presented in the form of a table below,

Table 2. Criteria for student response analysis

Percentage (%)	Category
81-100	Very valid (feasible to implement without improvements)
61-80	Valid(worth implementing with minor improvements)
41-60	Invalid (recommended not to be implemented because it needs major improvements)
21-40	Invalid (not worth implementing)
20	Very invalid (not worth implementing)

Level *Disseminate* This is done by distributing Application-based Interactive Science E-Modules *PocketBook* to analyze student responses in learning in two classes at SMPN 12 Jember.

Results and Discussion

The research results are described in several aspects contained in the validation results, limited scale student responses, class scale student responses, and distribution to obtain a valid E-Module. At stage Define, a needs assessment was carried out on teachers and students. The results of the teacher needs assessment showed that 100% of teachers (n=10) stated that the only resources applied in learning were textbooks and 100% of teachers (n=10) stated that they had never used application-based E-Modules. PocketBook on vibrations and waves. So it is necessary to develop an interactive, application-based Science E-Module PocketBook vibration and wave theme. Results needed assessment students showed that as many as 100% of students (n=120) stated that the only resources applied in learning were textbooks and 100% of students (n=120) stated that they had never used application-based E-Modules PocketBook on vibrations and waves. So it is necessary to develop an application-based interactive Science E-Module PocketBook vibration and wave theme. At the level of Design application-based E-Module design was carried out with PocketBook vibration and wave theme. The results of the E-Module design are as follows.

Table 3. Application-based E-Module Design PocketBook vibration and wave theme

E-Module Design Components		
Introduction	**Head**	**Closing**
a. Cover E-Module b. Cover Page c. Foreword d. List of contents e. E-Module Usage Guidelines f. E-Module Position Map g. Concept maps	a. Learning materials ● Vibration Material (explanation of vibration, amplitude, period, frequency, and example questions) ● Wave Material (explanation of waves, types of waves, and example questions) ● Sound Material (explanation of sounds, types of sounds, example questions) ● Exploring Digital Literacy ● Let's do an experiment ● Science Facts ● Evaluation b. Digital Literacy ● Viewing, searching, and filtering (data, information, and digital content) ● Evaluation (data, information, and digital content) ● Collaboration using digital technology ● Ethics in networking ● Security when exploring, communicating, and creating digital content ● Identify the advantages and disadvantages of digital content ● Describe digital content development ideas c. Creative Thinking ● Let's experiment 1 (Fluency of thinking) ● Let's experiment 2 (Flexibility of thinking) ● Let's experiment 3 (Elaboration) ● Let's experiment 4 (Originality)	a. Bibliography b. Profile c. Barcode E-Module

The E-Module design has been adjusted to the learning outcomes and learning objective flow in the independent curriculum. The E-Module display can be seen in the following image,
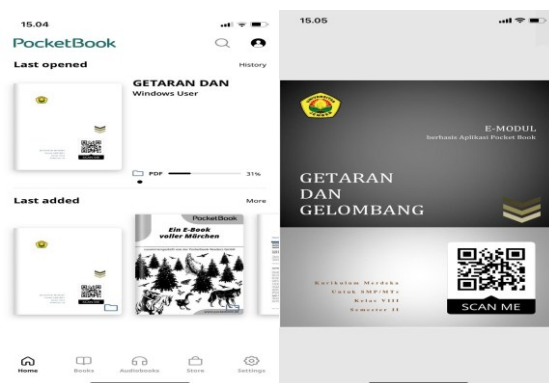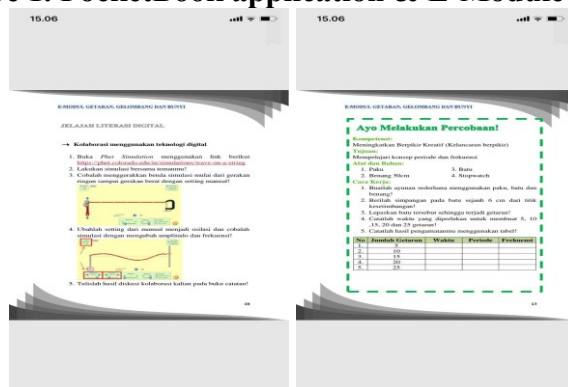
Figure 1. PocketBook application & E-Module Cover

Figure 2. Exploring Literasi Digital & Let's do an experiment (Creative Thinking)
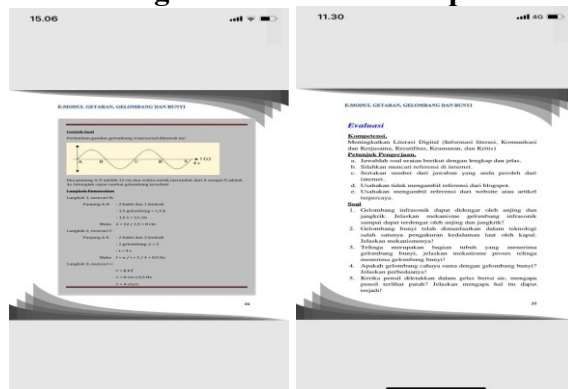

Figure 3. Sample Question & Evaluation

At the level of Develop Validation analysis of the application-based Science E-Module was carried out PocketBook by Experts and analysis of responses by students. Validation was carried out by 2 expert lecturers, namely Master of Science Education lecturers, and 2 practitioners, namely junior high school science teachers. Expert validation data by expert validators is shown in the table below.

Table 4. Data from the validation results of the application-based interactive Science E-Module PocketBook

No.	Validator	Mark	Category
1.	Member 1	77 %	Valid
2.	Member 2	81 %	Valid
3.	Practitioner 1	93 %	Very Valid
4.	Practitioner 2	93%	Very Valid
	Average	86%	Very Valid

Based on Table 4, it can be seen that the average value of the E-Module validation results is 86% so the E-Module is categorized as very valid. Next, a limited scale student response was carried out with 10 respondents in class 8F of SMPN 10 Jember. Limited-scale student response data is shown in the table below,

Table 5. Data on limited-scale student responses

Trials	The number of students	Average Score	Category
Limited Scale Trial	10	85,1%	Very Valid

Based on table 5, it can be seen that students' responses to the interactive science E-Module are application-based PocketBook the theme of vibrations and waves can be categorized as very valid, as evidenced by the average score obtained, namely 85.1%. This shows that the interactive science E-module is an application-based PocketBook with the theme of vibrations and waves is very suitable to be used and further class scale trials will be carried out. Furthermore, student responses on a class scale with 30 respondents were carried out at 8G SMPN 10 Jember. Class scale student response data is shown in the table below,

Table 6. Data on class scale student responses

Trials	The number of students	Average Score	Category
Class Scale Trial	30	86,6%	Very Valid

Based on table 6, it can be seen that students' responses to the interactive science E-Module are application-based PocketBook the theme of vibrations and waves can be categorized as very valid, as evidenced by the average score obtained, namely 86.6%. This shows that the interactive Science E-Module is an application-based PocketBook the theme of vibrations and waves is very suitable to be used and can be continued at the dissemination stage.

At the level of Disseminate An analysis of responses was carried out by students in two classes at SMPN 12 Jember. Student response data is shown in the table below,

Table 7. Data on student responses disseminate

Class	The number of students	Average Score	Category
8 A	30	81,9%	Very Valid
8 D	30	85,3%	Very Valid

Based on Table 7, it can be seen that students' responses to the interactive science E-Module are application-based PocketBook the theme of vibrations and waves can be categorized as very valid as evidenced by the average scores obtained respectively, namely 81.9% and 85.3%. This shows that the interactive Science E-Module is application-based PocketBook vibration and wave themes are very suitable to use.

Application-based interactive science e-module PocketBook vibration and wave theme is not like modules in general. The e-module developed is designed to increase students' digital literacy and creative thinking. So apart from students receiving material about vibrations and waves, students' digital literacy and creative thinking skills can be improved with application-based interactive Science E-Modules PocketBook. According to Ramadhan (2019), Digital literacy via the internet makes literacy develop from just accessing information to finding, understanding, utilizing, evaluating, and developing various digital information so that it has a positive impact, especially in the educational aspect. Then, according to Syahrin (2019), if students apply creative thinking, students can come up with varied ideas, and from these varied ideas students can come up with the best solutions for analyzing problems. Students can use this E-Module independently anywhere or with the help of a teacher when at school. Research related to the development of E-Modules in

science learning, namely research from Syahiddah (2021), resulted in the conclusion that the development of E-Modules in Science was categorized as suitable for implementation, proven by a validity percentage of 98.6% and was categorized as very valid and received very good responses from students.

Based on the results of the development carried out, researchers found that the interactive Science E-Module was an application-based PocketBook with the theme of vibrations and waves that can be used with or without teacher assistance. Application-based interactive science e-module PocketBook the theme of vibrations and waves adds to student learning resources which are not only limited to textbooks but also utilize existing technology while still paying attention to indicators of digital literacy and creative thinking. The statement by Yustika's (2020), that science learning in the current digital era influences the learning process in the classroom, such as how to utilize digital literacy in learning and teachers must understand how to manage this dynamic change. Likewise, according to Choirunnisa's (2023) statement creative thinking skills can be correlated with problem-solving skills, where a person's creative thinking can overcome the problems faced based on the ideas generated. So with the interactive Science E-Module, the theme of vibrations and waves is application-based PocketBook students and teachers each benefit.

Conclusion

Based on the results of development research, it can be concluded that the interactive Science E-Module is an application-based PocketBook the vibration and wave theme is very suitable for use and is valid according to the criteria. This is shown by the results of the validity percentage which is 86% by expert validators. The percentage of response results from the limited scale and class scale tests at SMPN 10 Jember were respectively 85.1% and 86.6%, each score can be categorized as very valid. Application-based interactive science e-module PocketBook It not only contains material but there are also assignments to improve students' digital literacy and creative thinking. Application-based interactive science e-module PocketBook the theme of vibrations and waves has also been distributed to two classes at SMPN 12 Jember with student response scores of 81.9% and 85.3% respectively. An interactive science e-module with application-based vibration and wave themes PocketBook Students and teachers both benefit from learning.

Recommendation

Based on the results of development research, some recommendations can be followed up as follows: (1) For teachers, they should continue using application-based interactive Science E-Modules PocketBook the theme of vibrations and waves during learning, so that students get additional learning resources that can be used at school and outside of school. (2) For other researchers, it is hoped that this research article can become a reference for developing media or teaching materials for junior high school students.

References

Afwina, D. A., P, P. D. A., & Budiarso, A. S. (2021). Pengembangan Modul Berbasis STEM (Science , Technology , Engineering , and Mathematics) Pokok Bahasan Alat-Alat Optik dalam Pembelajaran IPA di SMP. *Jurnal Literasi Pendidikan Fisika*, *2*(2), 2–7.

Amin, M., Ibrahim, M., & Alkusaeri. (2022). Meta Analisis : Keefektifan Stem Terhadap Kemampuan Berpikir Kreatif Siswa. *Journal of Authentic Research on Mathematics*

Education (JARME), *4*(2), 248–262.Anisimova, E. S. (2020). Digital literacy of future preschool teachers. *Journal of Social Studies Education Research*, *11*(1), 230–253.

Arslantas, T. K., & Gul, A. (2022). Digital literacy skills of university students with visual impairment: A mixed-methods analysis. *Education and Information Technologies*, *27*(4), 5605–5625. https://doi.org/10.1007/s10639-021-10860-1

Asri, A. S. T., & Dwiningsih, K. (2022). Validitas E-Modul Interaktif sebagai Media Pembelajaran untuk Melatih Kecerdasan Visual Spasial pada Materi Ikatan Kovalen. *PENDIPA Journal of Science Education*, *6*(2), 465–473.

Aydin, E., & Erol, S. (2021). The Views of Turkish Language Teachers on Distance Education and Digital Literacy during Covid-19 Pandemic. *International Journal of Education and Literacy Studies*, *9*(1), 60–71. https://doi.org/10.7575/aiac.ijels.v.9n.1p.60

Azizah, I. A., & Sucahyo, I. (2022). Flipbook-Based Digital E-book Learning Media on Mechanical Wave Materials to Practice Critical Thinking Skills. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *10*(3), 712. https://doi.org/10.33394/j-ps.v10i3.5474

Baharudin, R. Y., & Cholik, M. (2018). Pengembangan Media Pembelajaran PocketBook Berbasis Android Pada Mata Pelajaran Gambar Teknik Di Smk Negeri 1 Sidoarjo Mochamad Cholik Abstrak. *JPTM*, *11*(1), 133–138.

Buckingham, D. (2020). Epilogie: Rethinking Digital Literacy: Media education in the age of digital capitalism. *Digital Education Review*, *37*, 230–239.

Choirunnisa, Lely. (2023). Keefektifan E-Module Keanekaragaman Hayati berbasis Remap-TPS terhadap Keterampilan Berpikir Kreatif Peserta Didik. *JKPPK: Jurnal Kajian Penelitian Pendidikan dan Kebudayaan, 1(2),* 10-19.

Hasanah, M. 2021. "Analisis Kemampuan Berpikir Kreatif Matematis Kelas VIII SMP Pada Materi Statistika." MAJU, 8(1), 233–243.

Hikmaturrosyidah, N., & Rachmadiarti, F. (2022). Development Of Interactive E-Book Based On Multiple Intelligences Ecosystem Topic To Train Berpikir kreatifs. *Journal of Biology Education*, *11*(1), 89–101. http://journal.unnes.ac.id/sju/index.php/ujbe

Kurniawati, S., Lesmono, A. D., & Wahyuni, S. (2014). Pengembangan Bahan Ajar Interaktif Berbasis It Pada Pembelajaran Ipa Di Smp. *Jurnal Pendidikan Fisika*, *3*(3), 301–305.

Larasyanti, K. L., Fatmaryanti, S. D., & Al Hakim, Y. (2020). "Pengembangan PocketBook Of Physics (PBOP) Berbasis Android Sebagai Media Development of an Android-based PocketBook of Physics (PBOP) as a Physics Learning Media". Jurnal Inovasi Pendidikan Sains (JIPS), 1(2), 68–72.

Lesmono, A. D., Wahyuni, S., & Alfiana, R. D. N. (2012). Pengembangan Bahan Ajar Fisika Berupa Komik Pada Materi Cahaya Di Smp Albertus D Lesmono, Sri Wahyuni, Ria Dita N Alfiana. *Jurnal Pembelajaran Fisika*, *1*(1), 100–105.

Lesmono, A. D., Wahyuni, S., & S, F. (2012). Pengembangan Petunjuk Praktikum Fisika Berbasis Laboratorium Virtual (Virtual Laboratory) Pada Pembelajaran Fisika Di Smp / Mts. *Jurnal Pembelajaran Fisika*, *1*(3), 272–277.

Liu, Z. J., Tretyakova, N., Fedorov, V., & Kharakhordina, M. (2020). Digital literacy and digital didactics as the basis for new learning models development. *International Journal of Emerging Technologies in Learning*, *15*(14), 4–18.

https://doi.org/10.3991/ijet.v15i14.14669

Prahani, B. K., Supeno, & Wahyuni, S. (2012). Pengembangan Perangkat Pembelajaran Fisika Berbasis Information And Communication Technology (Ict) Di Smp Binar Kurnia Prahani, Supeno, Sri Wahyuni. *Jurnal Pembelajaran Fisika*, *1*(1), 31–37.

Prianto, A., & Author, C. (2021). "Analisis Kemampuan Berpikir Kreatif Matematis Melalui Problem Posing Bersifat Open Ended." Jurnal Pengembangan Pembelajaran Matematika (JPPM), 3(1), 32–42.

Puspitasari, E., Putra, P. D. A., & Handayani, R. D. (2021). Pengembangan Buku Ajar Fisika Berbasis Science , Technology , Engineering , and Mathematics (STEM) pada Pokok Bahasan Suhu dan Kalor di SMA. *Jurnal Literasi Pendidikan Fisika*, *2*(1), 44–52.

Rahmawati, D., Wahyuni, S., & Yushardi. (2017). Pengembangan Media Pembelajaran Flipbook Pada Materi Gerak Benda Di Smp. *Jurnal Pembelajaran Fisika*, *6*(4), 326–332.

Ramadhan, S., Sukma, E., & Indriyani, V. (2019). Teacher competence in utilizing digital media literacy in education. *Journal of Physics: Conference Series*, *1339*(1). https://doi.org/10.1088/1742-6596/1339/1/012111

Ramadhani, W. N., Putra, P. D. A., & Novenda, I. L. (2021). Pengembangan Lembar Kerja Siswa (Lks) Berbasis Engineering Design Process (Edp) Pada Topik Pemanasan. *OPTIKA: Jurnal Pendidikan Fisika*, *6*(1), 1–13.

Rizkika, M., P, P. D. A., & Ahmad, N. (2022). Pengembangan E-LKPD Berbasis STEM pada Materi Tekanan Zat untuk Meningkatkan Kemampuan Berpikir Kritis Siswa SMP. *Pancasakti Science Education Journal*, *7*(April), 41–48. https://doi.org/10.4905/psej.v7i1.142

Rochmawati, Y., & Wahyuni, S. (2017). Authentic Assessment in Physics Learning Using Physics Chess Game for Senior High School. *International Journal of Learning and Teaching*, *3*(1), 15–18. https://doi.org/10.18178/ijlt.3.1.15-18

Rohman, A., Mustaji, M., & Fatirul, A. N. (2021). "Pengembangan E-Modul Interaktif Materi Sistem Bilangan Untuk Mendukung Pembelajaran Siswa Sekolah Menengah Kejuruan". Jurnal Inspirasi Pendidikan, 11(1), 61–71. https://doi.org/10.21067/jip.v11i1.5 306

Sa'dun Akbar. (2016). "*Instrument Perangkat Pembelajaran.*" Bandung: Remaja Rosdakarya.

Saprudin, Irfan Ahlak, Astuti Salim, Ade Hi Haerullah, Fatma Hamid, & Nurdin Abdul Rahman. (2022). Pengembangan e-Modul Interaktif Getaran dan Gelombang (eMIGG) untuk Pembelajaran IPA di SMP. *Jurnal Pendidikan Mipa*, *12*(1), 97–106. https://doi.org/10.37630/jpm.v12i1.549

Sugiono. 2019. "*Metode Penelitian dan Pengembangan.*" Bandung: Alfabeta

Syahiddah, D. S., Putra, P. D. A., & Supriadi, B. (2021). Pengembangan E-Modul Fisika Berbasis STEM (Science , Technology , Engineering , and Mathematics) Pada Materi Bunyi. *Jurnal Literasi Pendidikan Fisika*, *2*(1), 1–8.

Syahrin A, Dawud, Suwignyo H, & Priyatni E T. 2019. "Creative thinking patterns in student's scientific works Eurasian." Journal of Education Research 81 21–36 doi: 10.14689/ejer.2019.81.2

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). "Instructional development for training teachers of exceptional children: a sourcebook." Virginia: The Council for Exceptional Children.

Tohara, A. J. T., Shuhidan, S. M., Bahry, F. D. S., & Nordin, M. N. bin. (2021). Exploring Digital Literacy Strategies for Students with Special Educational Needs in the Digital Age. *Turkish Journal of Computer and Mathematics Education*, *12*(9), 3345–3358.

Ulandari, F. S., Wahyuni, S., & Bachtiar, R. W. (2018). Pengembangan Modul berbasis Saintifik untuk melatih kemampuan berpikir kritis pada materi gerak harmonis di SMAN Balung. *Jurnal Pembelajaran Fisika*, *7*(1), 15–21.

Voronin, Saienko, & Tolchieva. (2020). Digital Transformation of Pedagogical Education at the University. *Advances in Social Science, Education and Humanities Research*, *112*(1), 8–14. https://doi.org/10.20323/1813-145x-2020-1-112-8-14

Wahyuni, S., Putra, P. D. A., & Hidayati, S. A. (2022). Pengembangan Lembar Kerja Peserta Didik Elektronik berbasis Science , Technology , Engineering , and Mathematics untuk Meningkatkan Kreativitas Siswa SMP Sri Wahyuni *, Pramudya Dwi Aristya Putra , Siti Anisa Hidayati Pendahuluan Metode Penelitian ini men. *Jurnal Pendidikan Sains Indonesia*, *10*(3), 492–508. https://doi.org/10.24815/jpsi.v6i3.24244

Wahyuni, S. (2019). Edmodo-Based Blended Learning Model as an Alternative of Science Learning to Motivate and Improve Junior High School Students' Scientific Critical Thinking Skills. *IJET (International Journal of Emerging Technologies in Learning)*, *14*(7), 98–110.

Wahyuni, S., Putra, P. D. A., Rizki, L. K., & Narulita, E. (2021). The Development of E-Student Worksheet on Environmental Pollution to Improve Critical Thinking Skills of Junior High School Students. *Jurnal Penelitian Pendidikan IPA*, *7*(4), 723–728.

Wirayuda, R. P., Darmaji, & Kurniawan, D. A. (2022). Identification of Science Process Skills and Students' Creative Thinking Ability In Science Lessons. *Attractive : Innovative Education Journal*, *4*(1), 129–137. https://www.attractivejournal.com/index.php/aj/

Wulandari, C. Y., & Sulistyowati, R. (2022). Pengembangan E-Modul Interaktif Berbasis Flip Pdf Professional Mata Pelajaran Produk Kreatif dan Kewirausahaan di Sekolah Menengah Kejuruan. *EDUKATIF: JURNAL ILMU PENDIDIKAN*, *4*(3), 4882–4889.

Wiyono, Cammelia. 2023. "JTAM (Jurnal Teori Dan Aplikasi Matematika) Development of an E-Pocketbook to Develop Critical Thinking Skills and Problem-Solving Ability" 7 (4): 1026–42. http://journal.ummat.ac.id/index.php/jtam.

Wulandari, Fatika, Relsas Yogica, and Rahmawati Darussyamsu. 2021. "ANALISIS MANFAAT PENGGUNAAN E-MODUL JAUH DI MASA PANDEMI COVID-19." *Khazanah Pendidikan* 15 (2): 139–44. https://doi.org/10.30595/jkp.v15i2.10809.

Yustika, Gaung Perwira, and Sri Iswati. 2020. "Digital Literacy in Formal Online Education: A Short Review." *Dinamika Pendidikan* 15 (1): 66–76. https://doi.org/10.15294/dp.v15i1.23779.