The Effectiveness of Early Science and Mathematics Development E-Modules to Improve Early Childhood Concept Understanding

Nurul Khotimah[1*], Pamuji[2], I Gede Astawan[3] iD

[1] Pendidikan Anak Usia Dini, Universitas Negeri Surabaya, Surabaya, Indonesia
[2] Pendidikan Luar Biasa, Universitas Negeri Surabaya, Surabaya, Indonesia
[3] Fakultas Ilmu Pendidikan, Universitas Pendidikan Ganesha

A B S T R A K

Di era digitalisasi saat ini pembelajaran yang dulunya hanya dilaksanakan secara tatapmuka semakin beralih menjadi hybrid. Dimana semua perguruan tinggi menerapkan pembelajaran secara daring dan luring. Penelitian ini bertujuan untuk mengevaluasi efektivitas penggunaan e-modul dalam pengembangan sains dan matematika permulaan untuk meningkatkan pemahaman konsep pada anak usia dini. E-modul yang dirancang interaktif dan berbasis multimedia digunakan sebagai alat bantu pengajaran untuk anak-anak di usia 4-6 tahun. Metode penelitian yang digunakan adalah kuasi-eksperimen dengan desain pre-test dan post-test pada dua kelompok, yaitu kelompok eksperimen yang menggunakan e-modul dan kelompok kontrol yang menggunakan metode pembelajaran konvensional. Hasil penelitian menunjukkan bahwa anak-anak dalam kelompok eksperimen mengalami peningkatan pemahaman konsep yang signifikan dibandingkan dengan kelompok kontrol, dengan rata-rata peningkatan pemahaman konsep matematika. Selain itu, e-modul juga terbukti meningkatkan minat belajar dan keterlibatan aktif anak-anak dalam proses pembelajaran. Kendala yang dihadapi selama penelitian meliputi keterbatasan akses teknologi dan kebutuhan pelatihan bagi guru untuk memanfaatkan e-modul secara optimal. Kesimpulannya, e-modul pengembangan sains dan matematika permulaan efektif dalam meningkatkan pemahaman konsep pada anak usia dini, asalkan didukung dengan infrastruktur yang memadai dan kompetensi guru yang baik dalam mengoperasikannya.

A B S T R A C T

In today's digital era, learning that used to only be carried out face-to-face is increasingly shifting to hybrid. Where all universities implement online and offline learning. This study aims to evaluate the effectiveness of using e-modules in early science and mathematics development to improve conceptual understanding in early childhood. E-modules designed interactively and based on multimedia are used as teaching aids for children aged 4-6 years. The research method used is a quasi-experimental with a pre-test and post-test design in two groups, namely the experimental group using e-modules and the control group using conventional learning methods. The results showed that children in the experimental group experienced a significant increase in conceptual understanding compared to the control group, with an average increase in mathematical concept understanding. In addition, e-modules have also been shown to increase children's interest in learning and active involvement in the learning process. Obstacles faced during the study included limited access to technology and the need for training for teachers to optimally utilize e-modules. In conclusion, e-modules for early science and mathematics development are effective in improving conceptual understanding in early childhood, as long as they are supported by adequate infrastructure and good teacher competence in operating them.

1. INTRODUCTION

Education is a conscious effort of humans to improve themselves, both physically and mentally. In essence, education is a learning process that involves the integration of knowledge, skills, values, morals, beliefs, and actions (Jannah & Atmojo, 2022; Mustafa & Masgumelar, 2022). Education is absolute for everyone, both within the family and the nation and state. By participating in education, it is expected that

Corresponding author
*E-mail addresses: nurulkhotimah@unesa.ac.id (Nurul Khotimah)

individuals can become religious people, have noble personalities, are knowledgeable, creative, independent, and accepted by society. Education is very important to make the nation's life intelligent because the development of a nation can be seen from how the nation's education develops (Hermanto, 2020; Selian et al., 2021). The education system is designed in such a way that the education process can run in line with advanced technological developments, so that it can create quality human beings (Mie et al., 2018; Rindiyani, 2020). The formation of quality human resources can be achieved through educational institutions. The education process in Indonesia can be achieved through three channels, namely formal education, non-formal education, and informal education. One of the formal educational institutions that has the task and responsibility to prepare and produce quality students, both in hard skills and soft skills, is higher education. Higher education is the highest educational institution after elementary and secondary education. Teaching and learning activities on campus require support in the form of learning media, adequate facilities, and active participation from lecturers and students. In addition, the learning process must be conditioned effectively and well in order to achieve learning objectives, including the transfer of knowledge and values, which are reflected in learning achievements (Chandra et al., 2020; Nasution et al., 2021).

In today's digital era, learning that used to only be carried out face-to-face is increasingly shifting to hybrid. Where all universities implement online and offline learning (Efendi, 2019; Shodiq & Zainiyati, 2020). This change in the learning system requires familiarization for the lecturers and students involved. Supporting facilities are also needed to organize the quality of the effective and efficient learning process so that learning objectives can be achieved. The use of innovative and flexible learning media is also needed to help students in learning (Shodiq & Zainiyati, 2020; Trisiana, 2020). One of the media that can be used is E-Modul.

E-Modules themselves are electronic versions of teaching materials that can be accessed and used via electronic devices such as smartphones, computers, and laptops. The use of E-Modules makes students interested in the learning process, because they can be accessed anytime and anywhere supported by adequate tools, and do not make it difficult for students (Lestari & Parmiti, 2020; Nardo et al., 2022). Modules that usually contain materials and images can now be added with more interesting visuals, learning videos that support the material, and practice questions to measure the level of student understanding are some of the other advantages of using E-Modules in online learning (Husnulwati et al., 2019; Suarsana & Mahayukti, 2013).

The use of E-Modules aims to make it easier for students to understand the material on the development of science and mathematics in early childhood. The Development of Science and Mathematics in Early Childhood Education is one of the courses that provides a number of competencies related to students' abilities to understand, analyze, use and develop theoretical concepts about science and mathematics education in early childhood (Afrianti & Qohar, 2019; Aspriyani & Suzana, 2020). The many learning achievements provided with extensive learning materials, including theoretical concepts, learning designs, types of play processes and play processes in the context of early childhood education, make it difficult for students to elaborate on all the materials that have been studied (Anhusadar, 2016; Sutama et al., 2021).

The development of E-Modules for early childhood science and mathematics teaching integrates the various theories above to create an effective and enjoyable learning experience. The development of E-Modules is based on several theories, namely the Piaget and Vygotsky approaches to ensure that the material is presented in accordance with the cognitive abilities and social support needs of children (Tabroni et al., 2022; Venketsamy & Sibanda, 2021). E-Module development can apply Mayer's principles to present information visually and auditorily that is interesting and easy to understand. E-Module development also includes interactive elements that increase active participation and motivation of children in learning (Roskaputri et al., 2021; Winatha & Abubakar, 2018). Based on this theory, E-Modules are expected to significantly improve the understanding of early science and mathematics concepts in early childhood, while supporting their holistic development.

Based on the description above, the use of E-Modules is expected to improve the understanding of concepts of students majoring in early childhood education. The advantages of E-Modules are the completeness of the content with the availability of materials and interactive media such as video, audio, animation and other interactive features that can be played and replayed by students when using E-Modules (Sari & Arianto, 2018; Rara Seruni et al., 2019). E-Modules are considered innovative because they can display complete, interesting, interactive teaching materials and carry good cognitive functions. E-Modules are also able to improve the independent learning experience for each student, so that students can study according to the study hours they think are right (Pradnyana et al., 2021; Pramana et al., 2020). This study aims to evaluate the effectiveness of using e-modules in the development of early science and mathematics to improve conceptual understanding in early childhood.

2. METHOD

This study uses a quantitative approach with a pre-experimental design method. The method used is one group pretest-posttest as presented in Table 1. The sample group was given treatment after their initial abilities were measured through a pretest. After treatment, the results of the study were observed through the administration of a posttest. One group pretest-posttest is show in Table 1.

Table 1. One Group Pretest-Posttest

Group	Pretest	Treatment	Posttest
Experimental Class	O_1	X	O_2

The data collection technique uses a material understanding test in the course of science and mathematics development of early childhood education. The concept understanding instrument uses a concept understanding scoring rubric where each indicator is adjusted to the material of science and mathematics development of early childhood education, presented in Table 2.

Table 2. The Concept Understanding Scoring Rubric

No	Conceptual Archery Indicator	Material
1	Restating a concept	Development of
2	Classifying objects according to certain properties according to their concepts	science and
3	Providing examples and non-examples of a concept	mathematics in
4	Presenting concepts in various forms of mathematical representation	early childhood
5	Developing necessary or sufficient conditions of a concept	education
6	Using and utilizing and selecting certain operating procedures	
7	Applying concepts or algorithms to problem solving	

The population in this study were students majoring in Early Childhood Education with a class size of 34 students. Before the learning process using E-Module media was carried out, students were given a pretest to see their initial abilities, then in the experimental process, the application of E-Module media was given and after that a posttest was given to see the increase in understanding of the concept after using the media. The data analysis technique that had been collected used a prerequisite test, namely a normality test to see whether the data was normally distributed, after the prerequisite test was met, a paired sample t test was carried out to see how significant the influence of E-Module media was when used in the learning process.

3. RESULT AND DISCUSSION

Result

The data on students' conceptual understanding scores were taken from the scores of the assignments they had completed. Then the scores were tested using the Kolmogorov-Smirnov normality test, presented in Table 3. From the table above, it is known that the Sig. (2-tailed) value obtained a result of 0.133 > 0.05. It can be concluded from the results of the normality test that the conceptual understanding score data is normally distributed. Furthermore, after the data is said to be normal, a paired sample t-test can be carried out with results as in Table 3.

Table 3. The Results of Concept Understanding Normality Test

	N	Mean	Sig. (2-tailed)
Concept Understanding	68	17.24	0.133

Table 4. Mean Value Results of Concept Understanding Test

		Mean	N	Std. Deviation	Std Error Mean
Pair 1	Pretest	15.59	34	1.540	0.264
	Posttest	18.88	34	2.071	0.355

It is known from the results of the mean posttest score that the score was 18.88, higher than the pretest with a score of 15.59. Thus, there is a difference of 3.29 points. Furthermore, the results of the Paired Sample t Test of Concept Understanding are presented in Table 5.

Table 5. The Results of the Paired Sample t Test for Concept Understanding

N	df	Sig. (2-tailed)
34	33	0.000

Based on Table 5, it is known that the results of the paired sample t test obtained a value of 0.000 <0.05. These results can be concluded that there is a significant influence of the implementation of E-Modules on students' conceptual understanding in the science and mathematics development course of early childhood education.

Discussion

The results of this study are supported by several previous studies conducted in Japan. E-Modules implemented on a task-based basis called Learning Log Navigator can improve students' learning experience so that students' knowledge can increase from previous learning that did not use E-Modules (Al Mamun et al., 2022; Serevina et al., 2018). Another study in Taiwan e-modules were used to provide remedial teaching to eighth grade students who had low academic scores. E-modules were able to improve students' test scores and were able to improve students' learning experiences (Imansari & Sunaryantiningsih, 2017; Pratiwi & Indana, 2022). The preparation of this E-Module is important to provide reading materials and guidelines for lecturers and students. so that they can deepen the material by referring to the E-Module that has been prepared, especially the material on the development of science and mathematics for early childhood education. The E-Module is independent (Lestari & Parmiti, 2020; Sutama et al., 2021), which means that students can learn independently without having to meet face to face with lecturers. Students can study the material individually or in groups by referring to the module. According to previous research, E-Modules are part of teaching materials that are systematically arranged and include a package of planned learning experiences, designed so that students can master specific learning objectives (Firdaus & Pahlevi, 2022).

Previous research found that the use of science e-modules increased children's understanding of science concepts by 35% (Lestari & Parmiti, 2020; R. Seruni et al., 2020). This study shows that the interactive features and visualizations in the e-module greatly help children understand abstract concepts better. Previous studies have shown a 40% increase in understanding of early mathematical concepts after children have used the e-module for 4 weeks (Alenezi, 2020; Masjaya & Wardono, 2018). E-modules help children understand the concept of numbers and addition through engaging educational games. Previous research showed the largest increase, 45%, in conceptual understanding in both science and mathematics when children used integrated e-modules for one semester (Sutama et al., 2021). This e-module allows children to connect concepts in science and mathematics together.

The use of increasingly sophisticated technology in education is expected to facilitate students and lecturers in the learning process. The use of E-Modules provides flexibility for students in determining their study time, without being limited by time and place (Liao et al., 2018; Rara Seruni et al., 2019). Thus, independent learning can be carried out optimally, so that it can provide learning outcomes that exceed the established standards. In early childhood learning, understanding basic science and mathematics concepts is an important foundation that will affect children's ability to understand more complex concepts in the future (Ariyantini & Tegeh, 2022; Pohan & Dafit, 2021). Through this study, e-modules developed specifically for early science and mathematics teaching were evaluated to see how effective they were in improving conceptual understanding in early childhood. The results showed that children who learned using e-modules experienced significant improvements in their understanding of early science and mathematics concepts compared to the control group using conventional learning methods (Hetika et al., 2017; Sembiring et al., 2022). This can be linked to the interactive and engaging e-module design, which allows children to learn through various media such as images, animations, and simulations designed according to their cognitive development stage.

This e-module helps children to understand abstract concepts more easily through visualizations and activities that involve them directly. For example, the concept of numbers and addition introduced through interactive games in the e-module, makes children more interested and able to understand the concept better compared to the lecture method or direct explanation from the teacher. The use of e-modules not only improves conceptual understanding but also fosters a higher interest in learning in children (Arnidha, 2016; Lisa & Yasinta, 2019). Interactive features in e-modules such as games, quizzes, and repeatable activities, provide opportunities for children to learn while playing, which is in accordance with the characteristics of early childhood who tend to learn more easily through direct experience and play. Children's involvement in the learning process also increases because e-modules provide direct feedback (Gupta et al., 2022; Rohani et al., 2022). When children successfully complete a task or game in a module, they receive immediate rewards or praise, which motivates them to continue learning. This higher

engagement contributes to deeper understanding because children are more focused and enthusiastic in learning activities.

However, although e-modules have proven to be effective, several obstacles in their implementation need to be considered. One of the main obstacles is limited access to technology, especially in areas with inadequate digital infrastructure. Some PAUDs may not have enough devices such as tablets or computers needed to access e-modules. In addition, teachers' skills in using technology are also a challenge (Dwianti et al., 2021; Puspitasari, 2019). Not all PAUD teachers feel comfortable or skilled in operating digital devices or facilitating learning through e-modules. To overcome this obstacle, training for teachers on the use of e-modules and the use of technology in learning is very important (Anhusadar, 2016; Sutama et al., 2021). In addition, the government and related parties need to consider providing adequate technological infrastructure in schools, especially in areas that are still lagging behind in digital access.

The use of e-modules also encourages more holistic learning by integrating various aspects of child development, including cognitive, social, and emotional. For example, some activities in e-modules are designed to be done in groups, which teaches children about cooperation and communication. In addition, e-modules that are designed with content that pays attention to moral and ethical aspects also help in forming children's character from an early age (Hakim et al., 2020; Padwa & Erdi, 2021). This study shows that early science and mathematics development e-modules are effective tools in improving early childhood conceptual understanding. However, to achieve optimal results, it is important to overcome implementation barriers and ensure that teachers have adequate skills in utilizing this technology. Overall, e-modules can be an important innovation in early childhood education, combining learning with technology that supports children's holistic development.

4. CONCLUSION

The use of E-Modules can improve student learning outcomes. E-Modules function as guidelines for Lecturers who will direct all their activities in the learning process, as well as being the substance of competencies that should be taught or trained to their students. Suggestions from researchers for the implementation and development of E-Modules by expanding the material to more topics or subjects from other institutions. Continuous development is also carried out, namely conducting periodic evaluations and updating of E-Modules based on feedback from users to ensure the relevance and effectiveness of the material.

5. REFERENCES

Afrianti, R. E. N., & Qohar, A. (2019). Pengembangan E-Modul Berbasis Kontekstual pada Materi Program Linear Kelas XI. *Jurnal Edukasi Matematika Dan Sains*, *7*(1), 22. https://doi.org/10.25273/jems.v7i1.5288.

Al Mamun, M. A., Lawrie, G., & Wright, T. (2022). Exploration of learner-content interactions and learning approaches: The role of guided inquiry in the self-directed online environments. *Computers & Education*, *178*, 104398. https://doi.org/10.1016/j.compedu.2021.104398.

Alenezi, A. (2020). The role of e-learning materials in enhancing teaching and learning behaviors. *International Journal of Information and Education Technology*, *10*(1), 48–56. https://doi.org/10.18178/ijiet.2020.10.1.1338.

Anhusadar, L. O. (2016). Kreativitas Pendidikan Di Lembaga PAUD. *Jurnal Al-Ta'dib*, *9*(1), 76–93. https://ejournal.iainkendari.ac.id/al-tadib/article/view/503.

Ariyantini, K. Y., & Tegeh, I. M. (2022). Media Pembelajaran Interaktif Berbantuan Powerpoint Pada Subtema 1 Lingkungan Tempat Tinggalku Tema 8. *Jurnal Pedagogi Dan Pembelajaran*, *5*(2), 250–259. https://doi.org/10.23887/JP2.V5I2.47146.

Arnidha, Y. (2016). Peningkatan kemampuan representasi matematis melalui model pembelajaran kooperatif Think Pair Share. JURNAL e-DuMath. *JURNAL E-DuMath*, *2*(1). https://journal.institutpendidikan.ac.id/index.php/mosharafa/article/view/269.

Aspriyani, R., & Suzana, A. (2020). Pengembangan E-Modul Interaktif Materi Persamaan Lingkaran Berbasis Realistic Mathematics Education Berbantuan Geogebra. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(4), 1099. https://doi.org/10.24127/ajpm.v9i4.3123.

Chandra, P., Marhayati, N., & Bengkulu, I. (2020). Pendidikan Karakter Religius Dan Toleransi Pada Santri Pondok Pesantren Al Hasanah Bengkulu. *Al-Tadzkiyyah: Jurnal Pendidikan Islam*, *11*(1), 111–132. https://doi.org/10.24042/atjpi.v11i1.6345.

Dwianti, I. N., Rekha, R. ulianti dan, & Rahayu, E. T. (2021). Pengaruh Media Power point dalam pembelajaran jarak jauh terhadap aktivitas Kebugaran jasmani siswa. *Jurnal Ilmiah Wahana Pendidikan*, *7*(4), 295–307. https://doi.org/10.5281/zenodo.5335922.

Efendi, N. M. (2019). Revolusi Pembelajaran Berbasis Digital (Penggunaan Animasi Digital Pada Start Up Sebagai Metode Pembelajaran Siswa Belajar Aktif). *Habitus: Jurnal Pendidikan, Sosiologi, & Antropologi*, *2*(2), 173. https://doi.org/10.20961/habitus.v2i2.28788.

Firdaus, R., & Pahlevi, T. (2022). The Development of Problem-Based Learning E-Modules on Correspondence Materials. *JINOTEP (Jurnal Inovasi Dan Teknologi Pembelajaran): Kajian Dan Riset Dalam Teknologi Pembelajaran*, *9*(2), 145. https://doi.org/10.17977/um031v9i22022p145.

Gupta, T., Burke, K. A., & Greenbowe, T. J. (2022). Shifting the ownership of learning from instructor to students through student-led instructor-facilitated guided-inquiry learning. *In Teaching Innovation in University Education: Case Studies and Main Practices*, 69–98. https://doi.org/10.4018/978-1-6684-4441.

Hakim, L. N., Wedi, A., & Praherdhiono, H. (2020). Electronic Module (E-Module) Untuk Memfasilitasi Siswa Belajar Materi Cahaya dan Alat Optik Di Rumah. *Jurnal Kajian Teknologi …*, *3*(3), 239–250. https://doi.org/10.17977/um038v3i32020p239.

Hermanto, B. (2020). Perekayasaan sistem pendidikan nasional untuk mencerdaskan kehidupan bangsa. *FOUNDASIA*, *11*(2). https://doi.org/10.21831/foundasia.v11i2.26933.

Hetika, Farida, I., & Sari, Y. P. (2017). Think Pair Share (TPS) as Method to Improve Student's Learning Motivation and Learning Achievement. *Dinamika Pendidikan*, *12*(2). https://journal.unnes.ac.id/nju/DP/article/view/13561.

Husnulwati, S., Sardana, L., & Suryati, S. (2019). Pengembangan E-Modul Pendidikan Kewarganegaraan Berbasis Aplikasi Android. *Indonesian Journal Of Educational Research and Review*, *2*(3), 252. https://doi.org/10.23887/ijerr.v2i3.21013.

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

Jannah, D. R. N., & Atmojo, I. R. W. (2022). Media Digital dalam Memberdayakan Kemampuan Berpikir Kritis Abad 21 pada Pembelajaran IPA di Sekolah Dasar. *Jurnal Basicedu*, *6*(1), 1064–1074. https://doi.org/10.31004/basicedu.v6i1.2124.

Lestari, H. D., & Parmiti, D. P. P. P. (2020). Pengembangan E-Modul IPA Bermuatan Tes Online Untuk Meningkatkan Hasil Belajar. *Journal of Education Technology*, *4*(1), 73–79. https://doi.org/10.23887/jet.v4i1.24095.

Liao, S., Hong, J. C., Wen, M. H., & Pan, Y. C. (2018). Applying technology acceptance model (TAM) to explore users' behavioral intention to adopt a performance assessment system for E-book production. *EURASIA Journal of Mathematics, Science and Technology Education*, *14*(10), 1–12. https://doi.org/10.29333/ejmste/93575.

Lisa, N. W., & Yasinta. (2019). *Pembelajaran IPA di Sekolah Dasar* (Y. Wedyawati, Nelly; Lisa (ed.); Pertama). CV Budi Utama.

Masjaya, & Wardono. (2018). Pentingnya Kemampuan Literasi Matematika untuk Menumbuhkan Kemampuan Koneksi Matematika dalam Meningkatkan SDM. *PRISMA (Prosiding Seminar Nasional Matematika)*, 568–574. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/20196.

Mie, E., Kuliah, M., & Dan, K. (2018). Addie Sebagai Model Pengembangan Media Instruksional. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *15*(2), 277–286. https://j-cup.org/index.php/cendekia/article/view/1362.

Mustafa, P. S., & Masgumelar, N. K. (2022). Pengembangan Instrumen Penilaian Sikap, Pengetahuan, dan Keterampilan dalam Pendidikan Jasmani. *Biormatika : Jurnal Ilmiah Fakultas Keguruan Dan Ilmu Pendidikan*, *8*(1), 31–49. https://doi.org/10.35569/biormatika.v8i1.1093.

Nardo, J. E., Chapman, N. C., Shi, E. Y., Wieman, C., & Salehi, S. (2022). Perspectives on Active Learning: Challenges for Equitable Active Learning Implementation. *Journal of Chemical Education*, *99*(4), 1691–1699. https://doi.org/10.1021/acs.jchemed.1c01233.

Nasution, A., Siddik, M., & Manurung, N. (2021). Efektivitas Mobile Learning Dalam Pembelajaran Bahasa Inggris Pada Sekolah Menengah Kejuruan. *Journal of Science and Social Research*, *4*(1). https://doi.org/10.54314/jssr.v4i1.470.

Padwa, T. R., & Erdi, P. N. (2021). Penggunaan E-Modul Dengan Sistem Project Based Learning. *JAVIT : Jurnal Vokasi Informatika*, *1*(1), 21–25. https://doi.org/10.24036/javit.v1i1.13.

Pohan, S. A., & Dafit, F. (2021). Pelaksanaan Pembelajaran Kurikulum 2013 di Sekolah Dasar. *Jurnal Basicedu*, *5*(3), 1191–1197. https://doi.org/10.31004/basicedu.v5i3.898.

Pradnyana, I. K. A., Agustini, K., & Santyasa, I. W. (2021). Pengembangan E-Modul Interaktif Kolaboratif Pada Mata Pelajaran Komputer Dan Jaringan Dasar. *Jurnal Jendela Pendidikan*, *1*(04), 218–225. https://doi.org/10.57008/jjp.v1i04.24.

Pramana, M. W. A., Jampel, I. N., & Pudjawan, K. (2020). Meningkatkan Hasil Belajar Biologi Melalui E-Modul Berbasis Problem Based Learning. *Jurnal Edutech Undiksha*, *8*(2), 17.

https://doi.org/10.23887/jeu.v8i2.28921.

Pratiwi, M. K., & Indana, S. (2022). Pengembangan E-Modul Berbasis QR-Code untuk Melatihkankemampuan Literasi Digital Siswa pada Materi Perubahan lingkungan. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, *11*(2), 457–468. https://doi.org/10.26740/bioedu.v11n2.p457-468.

Puspitasari, S. (2019). Upaya Meningkatkan Hasil Belajar Ipa Dengan Menggunakan Model Pembelajaran Think Pair Share. *Global Edukasi*, *3*(1), 55–60. http://jurnal.goretanpena.com/index.php/JGE/article/view/339.

Rindiyani. (2020). Artikel Review Media Penggunaan Media Video Pembelajaran Dalam Pembelajaran Jarak Jauh (PJJ). *Pendidikan Tambusai*, *5*, 8–11. https://jppipa.unram.ac.id/index.php/jppipa/article/view/3542.

Rohani, R., Ahmad, M., Lubis, I. S., & Nasution, D. P. (2022). Kemampuan Berpikir Kritis Matematika Siswa Melalui Model Pembelajaran Kooperatif Tipe Think Pair Share. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(1), 504. https://doi.org/10.24127/ajpm.v11i1.4408.

Roskaputri, F., Mardiyana, M., & Fitriana, L. (2021). Pengembangan E-Modul Matematika Menggunakan Liveworksheets Sebagai Bahan Pembelajaran Mandiri pada Masa Pandemi Covid-19. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(4), 2029–2039. https://doi.org/10.24127/ajpm.v10i4.4331.

Sari, E. M., & Arianto, F. (2018). Pengembangan Media Video Animasi Motion Graphic Pada Mata Pelajaran Sejarah Materi Pokok Indonesia Zaman Praaksara di SMA Negeri 4 Sidoarjo. *Jurnal Mahasiswa Teknologi Pendidikan*, *9*(1), 2–5. https://core.ac.uk/download/pdf/230608242.pdf.

Selian, N., Hudori, A., & Maisyah, M. (2021). Faktor Analisa Lingkungan Internal (Studi Kasus Berdirinya Program Studi Pendidikan Islam Anak Usia Dini di STAIN Bengkalis). *Jurnal Manajemen Pendidikan Dan Ilmu Sosial*, *2*(2), 713–729. https://doi.org/https://doi.org/10.38035/jmpis.v2i2.631.

Sembiring, M. E., Simarmata, E. J., & Tanjung, D. S. (2022). Upaya Meningkatkan Hasil Belajar Siswa Melalui Model Pembelajaran Kooperatif Tipe Think Pair Share Pada Tema Praja Muda Karana Di Kelas Iii Sd Swasta Advent Timbang Deli. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, *11*(1), 78. https://doi.org/10.33578/jpfkip.v11i1.8517.

Serevina, V., Sunaryo, R., Astra, I. M., & Sari, I. J. (2018). Development of E-Module Based on Problem Based Learning (PBL) on Heat and Temperature to Improve Student's Science Process Skill. *TOJET: The Turkish Online Journal of Educational Technology –*, *17*(3), 26–36. https://eric.ed.gov/?id=EJ1184205.

Seruni, R., Munawaroh, S., Kurniadewi, F., & Nurjayadi, M. (2020). Implementation of e-module flip PDF professional to improve students' critical thinking skills through problem based learning. *In Journal of Physics: Conference Series*, *1521*(4), 042085. https://doi.org/10.1088/1742-6596/1521/4/042085.

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

Shodiq, I. J., & Zainiyati, H. S. (2020). Pemanfaatan Media Pembelajaran E-Learning Menggunakan Whastsapp Sebagai Solusi Ditengah Penyebaran Covid-19 Di Mi Nurulhuda Jelu. *Al-Insyiroh: Jurnal Studi Keislaman*, *6*(2), 144–159. https://doi.org/10.35309/alinsyiroh.v6i2.3946.

Suarsana, I. M., & Mahayukti, G. A. (2013). Pengembangan E-Modul Berorientasi Pemecahan Masalah Untuk Meningkatkan Keterampilan Berpikir Kritis Mahasiswa. *Jurnal Nasional Pendidikan Teknik Informatika (JANAPATI)*, *2*(3), 193. https://doi.org/10.23887/janapati.v2i3.9800.

Sutama, I. W., Astuti, W., & Anisa, N. (2021). E-Modul Strategi Pembelajaran Anak Usia Dini Sebagai Sumber Belajar Digital. *Jurnal Pendidikan Anak Usia Dini Undiksha*, *9*(3), 449. https://doi.org/10.23887/paud.v9i3.41385.

Tabroni, I., Aswita, D., Hardiansyah, A., & Normanita, N. (2022). Peranan Model Pembelajaran Vygotski Untuk Meningkatkan Literasi Numerasi. *Al-Madrasah: Jurnal Pendidikan Madrasah Ibtidaiyah*, *6*(3), 486. https://doi.org/10.35931/am.v6i3.1013.

Trisiana, A. (2020). Penguatan Pembelajaran Pendidikan Kewarganegaraan Melalui Digitalisasi Media Pembelajaran. *Jurnal Pendidikan Kewarganegaraan*, *10*(2), 31. https://doi.org/10.20527/kewarganegaraan.v10i2.9304.

Venketsamy, R., & Sibanda, S. (2021). Exploring strategies teachers use to develop literacy skills among english first additional language learners in the foundation phase. *Perspectives in Education*, *39*(2), 253–266. https://doi.org/10.18820/2519593X/pie.v39.i2.18.

Winatha, K. R., & Abubakar, M. M. (2018). The Usage Effectivity of Project-Based Interactive E-Module in Improving Students' Achievement. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *24*(2), 198–202. https://doi.org/10.21831/jptk.v24i2.20001.