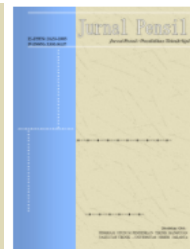


Available online at: <http://journal.unj.ac.id>

Jurnal
Pensil

Pendidikan Teknik Sipil



Journal homepage: <http://journal.unj.ac.id/unj/index.php/jpensil/index>

LITERATURE REVIEW: THE ROLE OF E-MODULES IN IMPROVING VOCATIONAL STUDENTS' SCIENTIFIC LITERACY SKILLS

Muhammad Nadir^{1*}, Riyan Arthur², Daryati³

^{1,2,3} Program Studi Pendidikan Teknik Bangunan Fakultas Teknik Universitas Negeri Jakarta, Jl. Rawamangun Muka Raya No. 11, DKI Jakarta, 13220, Indonesia

¹ MuhammadNadir_1503617048@mhs.unj.ac.id ² arthur@unj.ac.id ³ daryati_sr@unj.ac.id

Abstract

Scientific literacy as a part of the 21st century skill set has a strategic position at the vocational level in preparing graduates who are competent, ready to work, and have skills in communicating and collaboration in work. This study will provide an overview of the role of e-modules which are the most widely developed as teaching materials in improving the student' scientific literacy skills.. The research method used is a literature review by analyzing 5 most relevant national publication articles using the Google Scholar database. The results of the analysis of 5 articles show that e-modules not only answer the challenges of education in responding to technology, but also proven to play an active role in improving the scientific literacy skills of SMK students including critical and creative thinking skills in order to solve the problem. The e-modules contains aspects of scientific literacy and can be integrated with various learning approach according to the characteristic of vocational student, such as Problem Based Learning (PBL), Socio-Scientific Issues (SSI), Science Technology Engineering Mathematics (STEM) and Problem Based Learning (PBL) by the related occurency in daily life to help student build abilities which support scientific literacy skills.

Keywords: E-modules, 21st century skills, Scientific Literacy, Vocational Education

P-ISSN: [2301-8437](#)

E-ISSN: [2623-1085](#)

ARTICLE HISTORY

Accepted:

11 Agustus 2022

Revision:

11 September 2022

Published:

30 September 2022

ARTICLE DOI:

[10.21009/jpensil.v11i3.28673](https://doi.org/10.21009/jpensil.v11i3.28673)



Jurnal Pensil :

Pendidikan Teknik

Sipil is licensed under a

[Creative Commons](#)

[Attribution-ShareAlike](#)

[4.0 International License](#)

(CC BY-SA 4.0).

Introduction

The development of the current global era is marked by the need of a new set of skills known as 21st century skills (Lavi et al., 2021). The term of “21st century skills” has been widely used in the context of education about how education provides comprehensive skills training for students to become “ready to work” and “ready to live” human beings in the middle of increasingly global competition (Taar & Palojoki, 2022). The 21st century skills must include: knowledge, skills, attitude, value, and ethic (Valtonen et al., 2021). The mentioned skill is referred to the skills in communication, creative thinking, collaboration, understanding across cultures, and critical thinking (Teo et al., n.d.). The other skills which also being a part of 21st century skills are skills in reasoning, understanding content, and applying knowledge to solve the problem (Haug & Mork, 2021).

Scientific literacy is one of a set of 21st century skills that must be mastered by students. The term of scientific literacy was first used by Paul de Hart from Stanford University which means understanding science and applying it to the needs of society (Pantiwati & Husamah., 2015), but it has undergone changes in meaning throughout history which basically migrated from the ability to memorize the scientific literacy concept and laws to become more comprehensive skills by involving various aspects of knowledge, investigation, way of thinking, and the interaction of science, technology, environment, and society (Rusilowati et al., 2016; Valladares, 2021). Scientific literacy is defined as the skills that students have in thinking and processing information as well as analyzing and evaluating using a scientific mindset, so they can make decisions based on their knowledge and experience (Crowell &

Schunn, 2016; Miller & Czegan, 2016; Wright et al., 2016).

In the vocational education, scientific literacy has a strategic position because it requires students to be more focus on career, competency readiness, to communication and collaboration (Wang & Chen, 2019; Wannapiroon et al., 2021). This position of scientific literacy in vocational education which tends to be equated with academic education is need to be highlighted, considering they both have different characteristics. As vocational graduates are directed to be directly absorbed into the work/industry which is relevant to their skills, learning process in vocational prioritizes applicable competencies and practices (Jatmoko, 2013). Vocational education requires students to have skills in communication, think critically and creatively, and gave a good interpersonal skills in order to meet the increasingly fierce competition in industry (Basito et al., 2018). They emphasizes practice rather than concepts for the achievement of skills in their respective fields (Warwas & Helm, 2018). Scientific literacy plays a role in vocational education to guide students to be able to apply their knowledge in the context of work related to industry (Drummond & Fischhoff, 2017).

In order to fulfill the needs of student scientific literacy as a part of 21st century skills, current education also needs to optimize the function of technology as a form of adaptation to the digital era. The shift of teaching materials is one of the innovations created to increase student interest in learning (Herawati & Muhtadi, 2018). One of the teaching materials that has been widely developed is an e-module, which is an independent teaching material that was arranged in an electronic system in which it contains supporting media such as

figure, animations, audio, and video (Cahyanto & Afifulloh, 2020). E-modules are electronic versions of printed modules that are designed using certain software and help users to achieve the expected competencies according to their complexity, because e-modules are not only contain materials, but also methods, limitations, and evaluation methods in learning (Elvarita et al., 2020; Islamiy et al., 2018). This e-modules is developed in order to improve scientific literacy at various level of education by including activities which can triggers interaction and students' thinking skills (Dwi Atmaji & Maryani, 2018). Scientific literacy-based e-module is commonly using the daily occasion which is related to the current material being studied to be able to directly seeing the relationship between science and real life (Rahmatullah et al., 2021). By using the scientific literacy-based e-modules, students are expected not only to learn, but also to increase the capacity for scientific knowledge, identify questions, draw conclusions based on the fact related to the scientific concepts, to making decisions with or without teachers (Nurjannati et al., 2016).

This study will explain how the role of e-modules in improving students' scientific literacy skills, especially in vocational education, using various supported and relevant sources/references. This study is expected to provide an overview about the importance of digital teaching materials in learning process in order to facilitate students in improving skills of 21st era, especially scientific literacy skills.

Research Methods

This study used a literature review method, which is a literature study whose data presentation uses references related to

the research objectives. This study is conducted by analyzing 5 articles in national publications which is related to the scientific literacy e-modules in vocational education. The minimum number of the development of scientific literacy e-modules in vocational level compared to other levels become a limitation in number of articles analyzed. Articles are collected by using Google Scholar database. The articles chose based on the inclusion criteria which has determined as follow: (1) the article objectives is to developing e-modules to improve students' scientific literacy skills; and (2) the subject of the study is vocational students.

Results and Discussion

Scientific literacy skills are considered very important for students in understanding issues and solving problems in daily life. Scientific literacy is a skill that student mastered to recognize concepts, understand, explain, communicate, and solve the problems and issues in daily life related to the material has been studied, so that students have a positive attitude and apply high sensitivity towards themselves and the society (Yuliati, 2017). By seeing the characteristic of scientific literacy which emphasizes the achievement of scientific literacy skills, so that the learning process is not only memorizing knowledge, but also have to be process-oriented and the formation of scientific attitude to solve problems. Students must be equipped with the critical and creative thinking skills to build the scientific literacy skills (Kurniawati et al., 2021).

As the characteristics of 21st century learning process is a process that involves interaction between teachers and students according to the progress of science and technology, the selection of teaching

materials in the learning process plays an important role in achieving competency standards and basic competencies that must be achieved by students (Magdalena et al., 2020). A practical way to improve the scientific literacy skills in the learning process is present material that contains facts, concepts, principles, and laws in the teaching materials used (Muzijah et al.,

2020). The development of e-modules is an alternative way that is widely conducted to facilitate the learning process at various levels of education. The following table is shown the results of the analysis of 5 articles that describe the importance of e-modules in improving students' scientific literacy skills, especially at vocational level.

Table 1. The Analysis Result of 5 Relevant Articles

Author (s) (Year)	Title	E-Module Learning Characteristics	Results
Sulistiani et al. (2022)	E-module with Android Appy Pie Based on Socio-Scientific Issues to Improve Students' Critical Thinking Skills	SSI Learning Approach	Improving the critical thinking skills of vocational students by presenting the materials based on issues or problems in scientific and social context.
Rahayu et al. (2020)	The Development of Project Based Learning (PjBl) Physics Module Using Analogies to Improve Scientific Literacy Skills on Temperature and Heat Materials for 10 th Grade Vocational Students	PjBl Learning Approach	Improving the ability of vocational students to think critically and solve the problems through PjBl learning syntax and scientific literacy indicators.
Cahyani et al. (2020)	The effectiveness of STEM-integrated Project Based Learning E-Module to the Creativity of Vocational Students	STEM-Integrated PjBl Learning Approaches	Improving the critical and creative thinking skills of vocational students in solving the problems. It emphasizes the creativity and innovation in generating ideas for problem solving.
Larasati et al. (2018)	The development of Problem Based Learning E-Module on Polymer Materials for 12 th Grade Student at SMK Ma'arif Nu 1 Sumpiuh	PBL Learning Approach	Improving the critical thinking skills of vocational students through discussion and management of problems that challenges students' intellectuality.
Syahputri et al. (2019)	Empirical Analysis of Scientific Literacy-Based E-Module as Learning Resources for Electromagnetic Radiation Materials	Content Based on the 4 Aspects of Scientific Literacy	Improving the scientific literacy skills of vocational students by training the logical, analytical, critical, and creative thinking, as well as the ability to collaboration.

Based on the literature review shown in Table 1, the development of e-modules as

one of the digital teaching materials is basically carried out to answer the technological challenges in providing

teaching materials that can facilitate the learning process and students to have skills in the 21st century era. Sulistiani et al., (2022) utilizing e-module in improving students' critical thinking skills at the vocational level through the Social-Science Issues (SSI) approach, meaning that the e-module present materials related to issues in scientific and social context. As a result, vocational students who used the e-module proved to have higher scores than students who did not use the e-module. E-modules with the SSI approach are able to improve students' scientific literacy skills, because issues that are close to life experiences will increase interest and turn students into active learners (Tsai, 2018). The e-module with SSI approach will encourage students to engage in critical dialogue and practice scientific literacy skills including the ability to think scientifically, discuss, solve the problems, understand the interaction between science, technology, environment, and society, and build scientific attitudes (Anagün & Özden, 2010; Subiantoro, 2011).

Rahayu et al., (2020) shows that scientific literacy skills using e-modules with the Project Based Learning (PjBl) approach have increased in the moderate category. This e-module is structured with PjBl syntax using analogies in each learning activity completed by scientific literacy indicators. The flow in this e-module begins by representing important questions, designing plans for the given projects, to solving problems in it. PjBl activities can change the tendency of students who are passive to become active (Mulyadi, 2016). E-modules with PjBl approach make students not only have technical skills, but also non-technical skills relevant to scientific literacy, namely the ability to think critically, solve problems, collaborate, to life-long leaning (Guo et al., 2020).

Cahyani et al., (2020) presents the effectiveness of the use of e-module that are not only to build critical thinking skills, but also the creative thinking skills of vocational

students. According to the article, creativity and innovation are needed in solving the problems by providing new ideas that support the solution. This e-module packaged with Problem Based Learning (PBL) and Science technology Engineering Mathematics (STEM) approaches. This is in line with the article belonging to Larasati et al., (2018) who developing e-module with a PBL approach. This e-module is considered to be able to improve students' scientific literacy skills, because the PBL and STEM approaches are similar to the SSI approach which also presents problems related to daily occasions. Moreover, in the PBL approach which requires problem situations in order to challenges students in the terms of intellectuality, discussion, and management of problems or issues will help students to think critically. This means that PBL approach is effectively used for high-level learning which is also used as the development of learning materials in the realm of verbal information, intellectual skills, psychomotoric and attitudes that are relevant to the curriculum standards applied (Arini et al., 2021; Hasibuan et al., 2019).

Unlike the other four articles, Syahputri et al., (2019) presents the results of the development of the scientific literacy e-module that emphasized 4 aspects of scientific literacy as content in the e-module. The aspects consist of science as the body of knowledge, science as a way of investigation, science as a way of thinking, and interaction between science, technology, environment, and society (Rusilowati et al., 2016). This e-module is considered feasible to be used to improving the scientific literacy skills of vocational students. Students who use this e-module will be trained to have the ability to think logically, analytically, critically, creatively, as well as the ability to collaboration.

Overall, the e-modules are proven to be digital teaching materials that are able to support the scientific literacy skills of vocational students. This scientific literacy skills can be built through critical and creative thinking skills, problem solving, communication skills, and collaboration skills during learning process. The scientific literacy e-module must contain the aspects and indicators of scientific literacy and ensure that all aspects contained proportionally. The scientific literacy e-modules can also be integrated with the most appropriate learning approach and relate to the scientific contexts and problems in daily life, so that students knowing the relevance of the material being studied with real life condition. The use of scientific literacy e-modules can improve the quality of learning and students' scientific literacy skills as an effort of the fulfilment of skills needed in the 21st century era. With the skills mentioned, students will become graduates who are ready to compete globally and have sensitivity to the environment and society.

Conclusion

Based on the results of the discussions, the e-module has a strategic role in improving the scientific literacy skills of vocational students. The development of the e-modules is not only to answer the challenges in the digital era, but also facilitates students to build abilities that can support scientific literacy skills as part of 21st century skills. These abilities are built during learning process through activities and tasks that must be done by students independently and groups. In addition, the final evaluation of each lesson as well as the whole learning is also a synthesis of every science literacy-based learning. Two of them not only contain the learning process with activities that support scientific literacy skills, but have been based on indicators and

aspects of scientific literacy consisting of aspects of knowledge, investigation, way of thinking, and the interaction of science, technology, environment, and society. E-modules are flexible because they can be combined with the various learning approaches that are most suitable with the characteristics of vocational students.

References

- Anagün, Ş. S., & Özden, M. (2010). Teacher Candidate's Perceptions Regarding Socio-Scientific Issues And Their Competencies In Using Socio-Scientific Issues In Science And Technology Instruction. *Procedia - Social and Behavioral Sciences*, 9, 981–985.
<https://doi.org/https://Doi.Org/10.1016/J.Sbspro.2010.12.271>
- Arini, Y. S. W. E., Gunawan, W., & Subandowo, M. (2021). Pengembangan Modul IPA Terapan Berbasis Problem Based Learning Untuk Mendukung Pembelajaran Mandiri Di SMK. *Educate: Jurnal Teknologi Pendidikan*, 6(2), 72.
<https://doi.org/https://doi.org/10.32832/Educate.V6i2.5060>
- Basito, M. D., Arthur, R., & Daryati, D. (2018). Hubungan Efikasi Diri Terhadap Kemampuan Berpikir Tingkat Tinggi Siswa SMK Program Keahlian Teknik Bangunan Pada Mata Pelajaran Mekanika Teknik. *Jurnal Pendidikan Teknik Sipil*, 7(1), 21–34.
<https://doi.org/https://doi.org/10.21009/Pensil.7.1.3>
- Cahyani, A. E. M., Mayasari, T., & Sasono, M. (2020). Efektivitas E-Modul Project Based Learning Berintegrasi STEM Terhadap Kreativitas Siswa SMK. *Jurnal Ilmiah Pendidikan Fisika*, 4(1), 15.
<https://doi.org/https://doi.org/10.20527/Jipf.V4i1.1774>
- Cahyanto, B., & Afifulloh, M. (2020). Electronic Module (E-Module)

- Berbasis Component Display Theory (CDI) Untuk Matakuliah Pembelajaran Terpadu. *JINOTEP (Jurnal Inovasi Dan Teknologi Pembelajaran): Kajian Dan Riset Dalam Teknologi Pembelajaran*, 7(1), 49–56. <https://doi.org/https://doi.org/10.17977/Um031v7i12020p049>
- Crowell, A., & Schunn, C. (2016). Unpacking The Relationship Between Science Education And Applied Scientific Literacy. *Research In Science Education*, 45(2), 129–140. <https://doi.org/https://doi.org/10.1007/S11165-015-9462-1>
- Drummond, C., & Fischhoff, B. (2017). Individuals With Greater Science Literacy And Education Have More Polarized Beliefs On Controversial Science Topics. *Proceedings Of The National Academy Of Sciences Of The United States Of America*, 9587–9592. <https://doi.org/https://Doi.Org/10.1073/Pnas.1704882114>
- Dwi Atmaji, R., & Maryani, I. (2018). Pengembangan E-Modul Berbasis Literasi Sains Materi Organ Gerak Hewan Dan Manusia Kelas V SD. *In Fundamental Pendidikan Dasar*, 1(1).
- Elvarita, A., Iriani, T., & Handoyo, S. S. (2020). Pengembangan Bahan Ajar Mekanika Tanah Berbasis E-Modul Pada Program Studi Pendidikan Teknik Bangunan, Universitas Negeri Jakarta. *Jurnal PenSil*, 9(1), 1–7.
- Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A Review Of Project-Based Learning In Higher Education: Student Outcomes And Measures. *International Journal Of Educational Research*. <https://doi.org/https://Doi.Org/10.1016/J.Ijer.2020.101586>
- Hasibuan, M. P., Sari, R. P., & Setiawaty, S. (2019). Penerapan Model Pembelajaran Dengan Pendekatan Saintifik Terhadap Pembentukan Habits of Mind Siswa. *Jurnal IPA & Pembelajaran IPA*, 3(2), 119–129. <https://doi.org/https://Doi.Org/10.24815/Jipi.V3i2.14415>
- Haug, B. S., & Mork, S. M. (2021). Taking 21st Century Skills From Vision To Classroom: What Teachers Highlight As Supportive Professional Development In The Light Of New Demands From Educational Reforms. *Teaching And Teacher Education*. <https://doi.org/https://Doi.Org/10.1016/J.Tate.2021.103286>
- Herawati, N. S., & Muhtadi, A. (2018). Pengembangan Modul Elektronik (E-Modul) Interaktif Pada Mata Pelajaran Kimia Kelas XI SMA. *Jurnal Inovasi Teknologi Pendidikan*, 5(2), 180–191. <https://doi.org/https://Doi.Org/10.21831/Jitp.V5i2.15424>
- Islamiy, S. A., Sunaryanti, Y., Rahman, A. K., & Mulawarman. (2018). Fenomena Penggunaan Media Sosial: Tantangan Kehidupan Siswa di Era Disrupsi Ditinjau dari Aspek Sosial pada Masa Perkembangan Remaja. *Proceeding Seminar Nasional Bimbingan Dan Konseling*, 94–102.
- Jatmoko, D. (2013). Relevansi Kurikulum SMK Kompetensi Keahlian Teknik Kendaraan Ringan Terhadap Kebutuhan Dunia Industri Di Kabupaten Sleman. *Jurnal Pendidikan Vokasi*, 3(1), 1–13. <https://doi.org/https://Doi.Org/10.21831/Jpv.V3i1.1572>
- Kurniawati, T. D., Akhdinirwanto, R. W., & Fatmaryanti, S. D. (2021). Pengembangan E-Modul Menggunakan Aplikasi 3D Pageflip Professional Untuk Meningkatkan Kemampuan Literasi Sains Peserta Didik. *Jurnal Inovasi Pendidikan Sains (JIPS)*, 2(1), 32–41. <https://doi.org/https://Doi.Org/10.37729/Jips.V2i1.685>
- Larasati, M., Fibonacci, A., & Wibowo, T. (2018). Pengembangan Modul Berbasis Problem Based Learning Pada Materi Polimer Kelas XII SMK Ma'arif Nu 1 Sumpiuh. *JTK (Jurnal*

- Tadris Kimiya*, 3(1), 32–41.
<https://doi.org/https://Doi.Org/10.15575/Jtk.V3i1.2038>
- Lavi, R., Tal, M., & Dori, Y. J. (2021). Perceptions Of STEM Alumni And Students On Developing 21st Century Skills Through Methods Of Teaching And Learning. *Studies In Educational Evaluation*, 70.
<https://doi.org/https://Doi.Org/10.1016/J.Stueduc.2021.101002>
- Magdalena, I., Sundari, T., Nurkamilah, S., & Ayu Amalia, D. (2020). Analisis Bahan Ajar. *Jurnal Pendidikan Dan Ilmu Sosial*, 2(2).
<https://doi.org/https://Ejournal.Stitpn.Ac.Id/Index.Php/Nusantara>
- Miller, D. M., & Czegán, D. A. C. (2016). Integrating The Liberal Arts And Chemistry: A Series Of General Chemistry Assignments To Develop Science Literacy. *Journal Of Chemical Education*, 93(5), 864–869.
<https://doi.org/https://Doi.Org/10.1021/Acs.Jchemed.5b00942>
- Mulyadi, E. (2016). Penerapan Model Project Based Learning Untuk Meningkatkan Kinerja Dan Prestasi Belajar Fisika Siswa SMK. *Jurnal Pendidikan Teknologi Dan Kejuruan*, 22(4), 385.
<https://doi.org/https://Doi.Org/10.21831/Jptk.V22i4.7836>
- Muzijah, R., Wati, M., & Mahtari, S. (2020). Pengembangan E-Modul Menggunakan Aplikasi Exe-Learning Untuk Melatih Literasi Sains. *Jurnal Ilmiah Pendidikan Fisika*, 4(2), 89.
<https://doi.org/https://Doi.Org/10.20527/Jipf.V4i2.2056>
- Nurjannati, N., Rahmad, M., & Irianti, M. (2016). Pengembangan E-Modul Berbasis Literasi Sains Pada Materi Radiasi Elektromagnetik. *Jurnal Pendidikan Fisika*, 2(1), 1–11.
- Pantiwati, Y., & Husamah. (2015). Analisis Kemampuan Literasi Sains Siswa SMP Kota Malang. In I. W. Surata & I. K. Suarnaya (Eds.), *Konferensi Tahunan Himpunan Evaluasi Pendidikan Indonesia (HEPI)*, 158–174.
- Rahayu, P. P., Masykuri, M., & Suparmi. (2020). *Pengembangan Modul Fisika Project Based Learning (Pjbl) Menggunakan Analogi Untuk Meningkatkan Keterampilan Literasi Ilmiah Materi Temperatur Dan Kalor Siswa Kelas X SMK*. Universitas Sebelas Maret.
- Rahmatullah, M. F., Pasani, C. F., & Yulinda, R. (2021). Pengembangan Bahan Ajar Berbasis Literasi Sains Bermuatan Karakter Toleransi Untuk Siswa SMP Pada Materi Pewarisan Sifat. *Jurnal Pahlawan*, 17(02), 1–10.
- Rusilowati, A., Nugroho, S. E., & Susilowati, S. M. (2016). Development Of Science Textbook Based On Scientific Literacy For Secondary School. *Jurnal Pendidikan Fisika Indonesia*, 12(2), 98–105.
<https://doi.org/https://Doi.Org/10.15294/Jpfi.V12i2.4252>
- Subiantoro, A. W. (2011). Socio-Scientific Issues And Its Potency On Biology Instruction For Character Education In Indonesia. *Proceeding Of The 4th Inter- National Conference On Science And Mathematics Education*, 136–144.
- Sulistiani, Kartimi, & Cahyati Sahrir, D. (2022). E-Modules With Android Appy Pie Based On Socio-Scientific Issues To Improve Students' Critical Thinking Skills. *Journal Of Education Technology*, 6(2), 372–379.
<https://doi.org/https://Doi.Org/10.23887/Jet.V>
- Syahputri, Z., Rahmad, M., & Veranita, D. (2019). Empirical Analysis Of E-Module Based On Science Literation As A Source In Learning Electromagnetic Radiation Material. *Jurnal Geliga Sains (JGS): Jurnal Pendidikan Fisika*, 7(2), 128–137.
<https://doi.org/https://Jgs.Ejournal.Unri.Ac.Id/Index.Php/JGS>

- Taar, J., & Palojoki, P. (2022). Applying Interthinking For Learning 21st-Century Skills In Home Economics Education. *Learning, Culture and Social Interaction*, 33. <https://doi.org/Https://Doi.Org/10.1016/J.Lcsi.2022.100615>
- Teo, T., Unwin, S., Scherer, R., & Gardiner, V. (n.d.). Initial Teacher Training For Twenty-First Century Skills In The Fourth Industrial Revolution (IR 4.0): A Scoping Review. *Computers And Education*, 170. <https://doi.org/Https://Doi.Org/10.1016/J.Compedu.2021.104223>
- Tsai, C. Y. (2018). The Effect Of Online Argumentation Of Socio-Scientific Issues On Students' Scientific Competencies And Sustainability Attitudes. *Computers And Education*, 14–27. <https://doi.org/Https://Doi.Org/10.1016/J.Compedu.2017.08.009>
- Valladares, L. (2021). Scientific Literacy And Social Transformation: Critical Perspectives About Science Participation And Emancipation. *Science And Education*, 30(3), 557–587. <https://doi.org/Https://Doi.Org/10.1007/S11191-021-00205-2>
- Valtonen, T., Hoang, N., Sointu, E., Näykki, P., Virtanen, A., Pöysä-Tarhonen, J., Häkkinen, P., Järvelä, S., Mäkitalo, K., & Kukkonen, J. (2021). How Pre-Service Teachers Perceive Their 21st-Century Skills And Dispositions: A Longitudinal Perspective. *Computers In Human Behavior*, 116. <https://doi.org/Https://Doi.Org/10.1016/J.Chb.2020.106643>
- Wang, Y., & Chen, Y. (2019). Review And Prospect Of The Research On Vocational Core Literacy Of Secondary Vocational School Students. *Vocational Education*, 08(03), 115–122. <https://doi.org/Https://Doi.Org/10.12677/Ve.2019.83020>
- Wannapiroon, P., Nilsook, P., Techakosit, S., & Kamkhuntod, S. (2021). STEM Literacy Of Students In Vocational Education. *International Journal Of Technology In Education And Science*, 5(4), 527–549. <https://doi.org/Https://Doi.Org/10.46328/Ijtes.253>
- Warwas, J., & Helm, C. (2018). Professional Learning Communities Among Vocational School Teachers: Profiles And Relations With Instructional Quality. *Teaching And Teacher Education*, 42–55. <https://doi.org/Https://Doi.Org/10.1016/J.Tate.2018.03.012>
- Wright, K. L., Franks, A. D., Kuo, L. J., Mctigue, E. M., & Serrano, J. (2016). Both Theory And Practice: Science Literacy Instruction And Theories Of Reading. *International Journal Of Science And Mathematics Education*, 14(7), 1275–1292. <https://doi.org/Https://Doi.Org/10.1007/S10763-015-9661-2>
- Yuliati, Y. (2017). Literasi Sains Dalam Pembelajaran IPA. *Jurnal Cakrawala Pendas*, 3(2), 21–28.