

Systematic review: Barcode link modules for interactive science and math learning in Indonesian High Schools

Fransiska Romana Febrianti ^{a,1,*}, Mohammad Masykuri ^{a,2}, Endang Susilowati ^{a,3}

^a Chemistry Education Department, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Jl. Ir. Sutami No. 36A, Surakarta, Central Java 57126, Indonesia

¹ fransiskaromanafabri@gmail.com*, ² mmasykuri@staff.uns.ac.id., ³ endang_s70@staff.uns.ac.id

*Corresponding author

Citation: Febrianti, F.; Masykuri, M.; Susilowati, E. (2024). Systematic review: Barcode link modules for interactive science and math learning in Indonesian High Schools. *Research and Development in Education (RaDEn)*, 4(2), 1391-1396. <https://doi.org/10.22219/raden.v4i2.33710>

Received: 20 May 2024

Revised: 21 November 2024

Accepted: 22 November 2024

Published: 26 December 2024



Copyright © 2024, Febrianti et al.

This is an open access article under the CC-BY-SA license

Abstract: There are still researchers who point out the need to strengthen the theoretical framework in developing QR-code based modules. Most of the articles reviewed pointed out relevant limitations or broader methods and a lack of mapping towards the use of QR-code based modules. This research aims to explore previous research related to the development of barcode-based modules (QR-Code) used in learning, especially for science and mathematics students in high schools in Indonesia. The authors used a systematic review following PRISMA guidelines. Articles sourced from EBSCOhost, Google Scholar, and Taylor and Francis. After reading the abstracts and conducting further searches, the authors identified 6 articles for systematic review. Researchers found that the barcode link-based module had a positive impact on learning. Most of the research articles were found in national journals, and most of the research was conducted on the islands of Java and Sulawesi. However, further analysis shows the need for growth in theoretical frameworks, development in other fields, and the availability of learning materials for research into learning media development, such as in chemistry education.

Keywords: barcode link; module; senior high school

1. Introduction

The Ministry of Education and Culture of the Republic of Indonesia (Kemendikbud RI) initiated the "Merdeka" curriculum to bring about changes in literacy assessment. This curriculum not only focuses on students' reading abilities but also encourages them to analyze reading content effectively (Zahrudin et al., 2021). Educators consider literacy skills as the most crucial aspect in learning and educational development at all levels. This view is based on a strong foundation, considering that students who excel in literacy and actively engage in literacy activities gain more valuable learning experiences compared to students with limited literacy skills (Thohir et al., 2022). The ability of students to receive and comprehend different types of learning in each subject makes teachers feel less capable of delivering the learning materials optimally (Veloo et al., 2013). Although teachers are able to deliver the subject matter effectively, they are still unable to capture the interest and actively engage students in the lessons (Vlassi & Karaliota, 2013). Therefore, there is a need for innovation in the development of teaching materials, such as modules, as supportive media for learning (Supasorn & Lordkam, 2014). The team has developed modules that cover real-life applications and contain comprehensive materials. However, the classroom learning methods that are still dominated by a teacher-centered approach have led to a lack of practical skills engagement and the ability to think critically among students. As a result, students tend to become passive and pay less attention to the teacher (Anjarsari et al., 2023).

In recent times, the emergence of various electronic learning tools has slightly shifted the use of printed modules as a means of learning (Cecep, 2013). Printed modules are less preferred by students because they have shortcomings such as the inability to comprehensively depict events, lack of interaction, and limited encouragement for learning from

diverse sources (Awwalina, 2022). Furthermore, the use of E-modules takes advantage of rapidly advancing technology, thereby enabling the creation of interactive learning experiences (Awwalina, 2022). Interactive learning patterns are realized through two-way or multi-directional communication, involving interactions between learning media, communication among students, and communication between students and teachers (Lukman et al, 2016). Electronic modules have several unique characteristics. Firstly, the file size of the modules is relatively small, making it easy to store them on a flash disk and conveniently carry them anywhere. Additionally, these modules can be used offline, allowing students to study them anytime and anywhere as long as a computer or laptop is available, which can enhance students' motivation to learn (Wiyoko et al., 2014). Based on research Awwalina, (2022) Students choose to use mobile phones or smartphones as an option in a learning system that utilizes QR code-based e-modules. This is because in the current millennial era, many students already own and use mobile phones. QR code is chosen based on research conducted by a researcher from Korea (Lee et al., 2011). Based on the description above, this research aims to explore previous studies related to the development of barcode-based (QR code) modules used in teaching, particularly for high school science students in Indonesia.

2. Materials and Methods

This paper employs a literature study technique using the Systematic Review (SR) method. Literature is obtained from both national and international journals. Systematic Review is a research approach used to comprehensively collect, evaluate, and interpret all relevant research findings related to a specific research question, topic, or phenomenon of interest (Siswanto, 2010). The systematic review in this research was conducted by searching for scholarly research publications using online article databases such as Google Scholar, EBSCOhost, and Taylor and Francis. One advantage of these databases compared to others is that they provide access to abstracts from over one million journal articles (Darmalaksana, 2020). The keywords used were module development, barcode link (QR code), and high school (SMA) in Indonesia. These keywords were created to search for words or phrases that might describe specific information. For example, if we are looking for information about the development of barcode-linked module at the high school level, the keywords that can be used are module development, barcode link (QR code), high school (SMA) in Indonesia. The article search process and screening flowchart can be seen in Figure 1 of the PRISMA Flowchart.

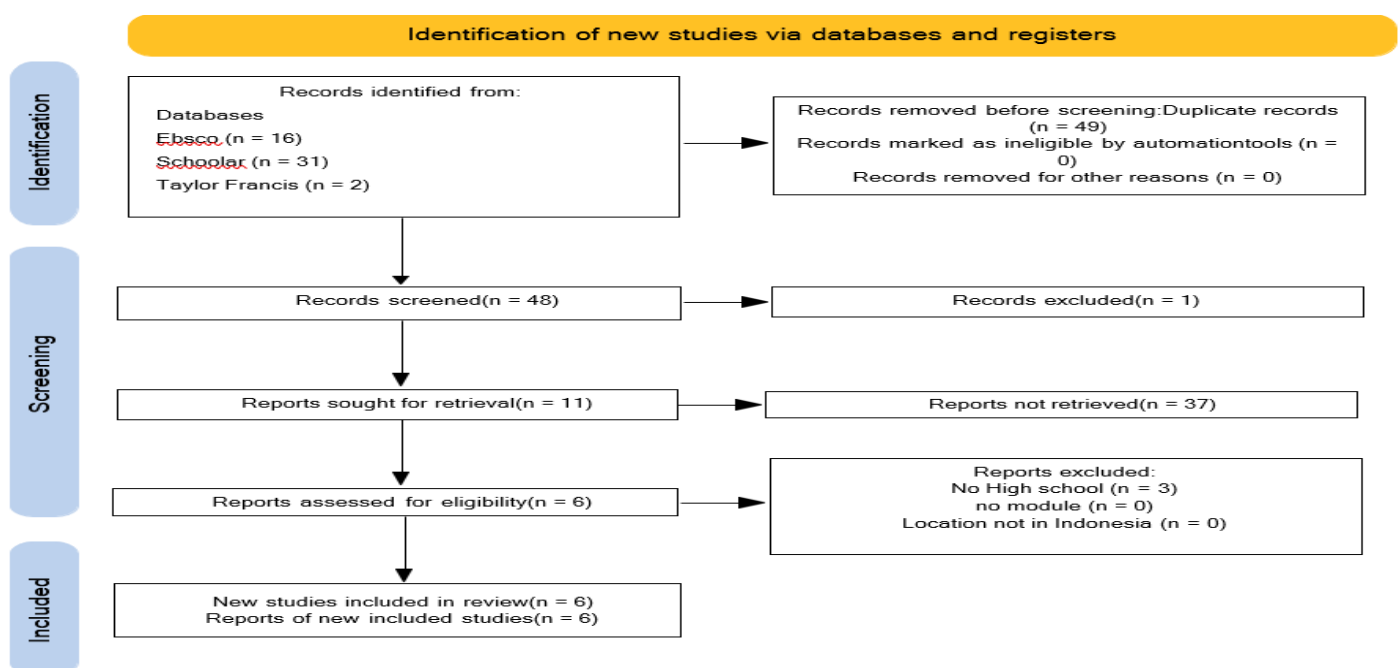


Figure 1. Prisma Flowchart

Analyzing this data by applying a qualitative approach in the systematic review is used to synthesize both qualitative and quantitative descriptive research findings. The process of this systematic review aims to synthesize research results to gain a deeper understanding of the development of barcode-linked e-modules. The literature sources are all derived from journal publications related to the development of barcode-linked module through systematic search methods.

3. Results

The researchers have summarized various types of articles that conducted research on the development of barcode-linked (QR code) learning modules at the high school level in Indonesia. Based on the results, the researchers found that there is an impact in using modules in learning, as shown in [Table 1](#).

Tabel 1. The Influence of Module Usage

Sources	Influence
Awwalina, N & Indana, S	Training student's scientific literacy in the topic of Ecosystem
Badriana, S., Apriani, H., & Marito, M	Learning support both in schools and outside the environment
Kristiawati., Wangsa, A., Fatmasari, P., & Usman, M	Overcoming the learning gap in mathematics class, particularly in the topic of function limits
Rahmah, M., Nurhidayah., & Nurmadina	Guided Inquiry-Based QR Code Practicum is said to be effective as a laboratory guide
Risdianto, E., Fitria, J., Johan, H., & Macariola, J	Training Student's critical thinking skills
Hariyanto, N., Dasmu, & Setiadi, A	Students become actively engaged in independent learning

4. Discussion

The table explains that there is mostly a positive influence in the use of modules during learning. This can be concluded that in the research and development of the modules, they can be considered valid. Just like in the research [Awwalina, \(2022\)](#) the research resulted in an interactive e-module based on QR Code to train scientific literacy of 10th-grade high school students on the topic of Ecosystem, which is considered valid based on the results of content validity, presentation and language validity, practicality, and effectiveness in training students' scientific literacy on the topic of Ecosystem. The barcode link in the research contains ecovideos, pretest/posttest, ecopuzzles, and ecojournals. In the research [Badriana et al., \(2021\)](#) the research resulted in QR-Code-based modules that assist both teachers and students in achieving learning goals inside and outside the classroom. In the research, the barcode link contained instructional videos. Additionally, there have been studies that developed smart mathematics books with the aim of addressing the gaps in mathematics learning in the classroom. The research included learning materials in the barcode link. Furthermore, there is another study [Rahmah et al., \(2023\)](#) another study has developed a guided inquiry-based laboratory guide. The barcode on the laboratory guide contains videos for learning purposes. There is a study [Risdianto et al., \(2020\)](#) a study has developed a module that is used to train students' critical thinking skills. The barcode in the module contains instructional videos. Furthermore, there is a study by [Hiva et al., \(2022\)](#) they developed a learning module to help learners become actively engaged in independent learning. The barcode link in the module contains video lessons, a Google Form link, and a virtual laboratory link (PhET). In addition, in the results of the systematic review, the researchers found that research on the development of barcode-linked module has been conducted on the islands of Java and Sulawesi, as shown in [Figure 2](#).

The regions that have been studied for the research are located in Java Island, specifically in West Java and East Java. Additionally, the development of modules has been studied in Sulawesi Island, specifically in South Sulawesi and West Sulawesi. This is

influenced by the relationship between the research and the location of universities, which resulted in the research being conducted in Java and Sulawesi Islands (Rosiatun et al., 2021).



Figure 2. Map of the Regions for the Development of Barcode-Linked

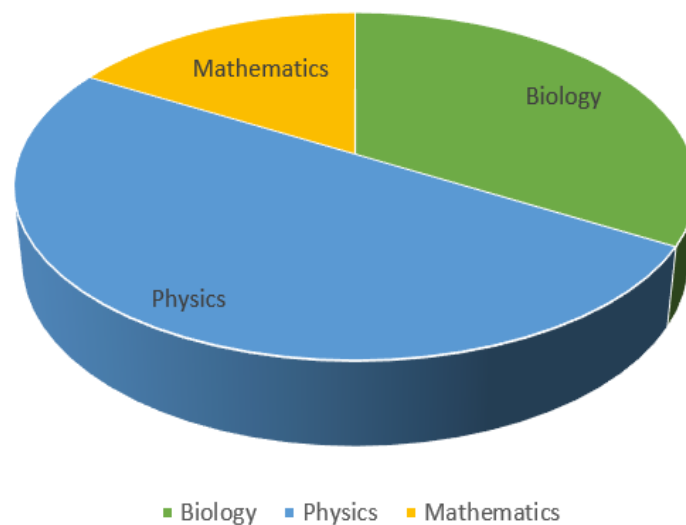


Figure 3. Researched Subjects/Subjects Investigated

In the Figure 3, it can be explained that previous researchers have developed barcode-based module in physics education, including topics such as Nuclear Physics and Thermodynamics. Additionally, in biology education, topics such as Ecosystem, Plants, and Photosynthesis have been investigated. Furthermore, in mathematics education, research has been conducted on the topic of Function Limits. The use of barcode modules in mathematics, physics, and biology education allows for personalized learning. Each student can scan the barcode to access materials that are suitable for their level of understanding. This helps address individual differences in comprehension and enables students to learn at a pace that meets their needs (Mawaddah et al., 2018). The lack of barcode-based module development in the field of chemistry is likely due to the ongoing process of further development to achieve desired goals, such as enabling independent learning for students and fostering their curiosity (Ramadhan, 2019). Furthermore, external support is crucial to ensure the continuous progress and development of E-Modules in line with the advancements of the times (Sesanti & Wahyuningtyas, 2022).

Systematic reviews related to instructional media help us better understand the performance of instructional media in the context of education. When conducting a systematic review, a filtering process is carried out before selecting and evaluating relevant literature to answer research questions. A systematic review provides valuable information for developing more effective and efficient instructional media to support the learning process. The results of a systematic review can provide information to educators, such as teachers and professors, about the impact of using barcode-based (QR-Code) modules in education, particularly in the STEM field in Indonesian secondary schools.

5. Conclusions

Research based on this systematic review has summarized various information related to the development of barcode-based (QR-Code) modules in the field of STEM in Indonesian secondary schools. This research reveals the influence of media on learning. The research findings also indicate the distribution of research articles, with the majority being conducted in Java and Sulawesi. In-depth analysis shows that researchers in Indonesia still have room to develop barcode-based learning media as interactive learning tools, especially in chemistry education.

Authors Contribution: Fransiska Romana Febrianti: methodology, conducting the research and writing original article, field data collection, data analysis, and revision. Mohammad Masykuri and E. Susilowati: Field data collection data analysis, and revision.

Conflict of Interest: The authors declare no conflict of interest.

6. References

- Anjarsari, F., Zahroh, U., Ratna, D., & Dewi, K. (2023). Pengembangan Modul Materi Ikatan Kimia Berbasis Guided Inquiry. *JIPK*, 17(1), 43–48. <https://doi.org/10.15294/jipk.v17i1.34845>
- Awwalina, N. M. (2022). Pengembangan E-Modul Interaktif Berbasis Qr Code Untuk Melatihkan Literasi Sains Siswa Kelas X SMA Pada Materi Ekosistem Development of QR Code Based Interactive E-module to Train Class X High School Student's Science Literacy Skills in Ecosystem Topics Sifak Indana. *Berkala Ilmiah Pendidikan Biologi*, 11(3), 712–721. <https://doi.org/10.26740/bioedu.v11n3.p712-721>
- Badriana, S., Apriani, H., & Marito, M. (2021). Pengembangan Modul Fisika Berbasis QR-CODE pada Pokok Bahasan Fisika Inti Kelas XII SMA. *Jurnal Ilmiah Mahasiswa Pendidikan Fisika*, 2(2), 124–132. <https://doi.org/10.30998/sch.v2i2.4363>
- Cecep, K. and S. B. (2013). *Media pembelajaran manual dan digital*. Bogor: Penerbit Ghalia Indonesia. <https://inlislite.uin-suska.ac.id/opac/detail-opac?id=20902>
- Darmalaksana, W. (2020). Sitasi Ilmiah Melalui Pengukuran Sinta Berbasis Google Scholar bagi Pencapaian Performa Pendidikan Tinggi Indonesia. *Jurnal Kelas Menulis*, 1. <https://etheses.uinsgd.ac.id/32599/1/CARA%20REKAP%20SITASI.pdf>
- Hiva H, N., Dasmo, & Setiadi, A. (2022). Pengembangan Modul Fisika Berbasis Saintifik Berbantuan QR Code Pada Materi Termodinamika Kelas XI SMA. *Jurnal Ilmiah Pendidikan Fisika*, 3(2), 129–136. <https://doi.org/10.30998/sch.v3i2.8093>
- Lee, J. K., Lee, I. S., & Kwon, Y. J. (2011). Scan & Learn! Use of quick response codes & smartphones in a biology field study. *American Biology Teacher*, 73(8), 485–492. <https://doi.org/10.1525/abt.2011.73.8.11>
- Lukman, S.M., & Ali, M.L. (2016). Smart Presensi Menggunakan QR-Code dengan Enkripsi Vigenerecipher. *J.Math and Its Appl*, 13(2), 31–44. <https://doi.org/doi:http://dx.doi.org/10.12962/j1829605X.v13i2.1933>

- Mawaddah, K., Kusuma, W.L., & Sunarmi, D. (2018). Pengembangan Media Interaktif Berbantuan Qr-Code Pada Materi Tumbuhan Paku Untuk Siswa SMA. *Jurnal Pendidikan Biologi*, 9(1). <http://dx.doi.org/10.17977/jpb.v9i1.3789>
- Rahmah, M. H., Nurhidayah, N., & Nurmadina, N. (2023). QR Code-Practicum Guide Based on Guided Inquiry as The Novel Biology Lab Activities Learning Assisted. *Jurnal Penelitian Pendidikan IPA*, 9(1), 180–185. <https://doi.org/10.29303/jppipa.v9i1.2511>
- Ramadhan, S. (2019). Pengembangan Materi Sains Sd/Mi Dengan Penggunaan Modul Dalam Pendekatan Contextual Teaching And Learning. *Jurnal Pemikiran Dan Penelitian Pendidikan Dasar*, 3(1), 1–14. <https://doi.org/10.52266/el-muhbib.v3i1.368>
- Risdianto, E., Fitria, J., Johan, H., & Macariola, J. S. (2020). Teacher's Perception of Thermodynamic Law Module Developed in Training through Student's Critical Thinking Skills. *Journal of Social Work and Science Education*, 1(1), 78. <https://doi.org/10.52690/jswse.v1i1.19>
- Rosiatun, A.H., Wardani, S., & Sumarni, W. (2021). The Development of Teaching Aids with Green Chemistry as A Learning Media for Thermochemical Materials. *Journal of Innovative Science Education*, 10(3), 286–291. <https://doi.org/10.15294/jise.v10i1.44857>
- Sesanti, N. R., & Wahyuningtyas, D. T. (2022). Inovasi E-Modul Berbasis Literasi Sains Dan Numerasi. *Jurnal Pengabdian Masyarakat Pendidikan Dasar*, 2(2), 107. <https://doi.org/doi:https://doi.org/10.29407/dedikasi.v2i2.19020>
- Siswanto. (2010). Systematic Review Sebagai Metode Penelitian Untuk Mensintesis Hasil-Hasil Penelitian (Sebuah Pengantar). *Buletin Penelitian Sistem Kesehatan*, 13(4), 326–333. <https://dx.doi.org/10.22435/bpsk.v13i4%20Okt.2766>
- Supasorn, S., & Lordkam, A. (2014). Enhancement of Grade 7 Students' Learning Achievement of the Matter Separation by using Inquiry Learning Activities. *Procedia - Social and Behavioral Sciences*, 116, 739–743. <https://doi.org/doi:https://doi.org/10.1016/j.sbspro.2014.01.290>
- Thohir, L., Udin, U., Isnaini, M., & Putera, L. J. (2022). Pelatihan Aplikasi Model Pembelajaran Membaca Teks Informasi Untuk Para Guru Bahasa Inggris SMA/SMK/MA Swasta di Kabupaten Lombok Timur. *Jurnal Gema Ngabdi*, 4(2), 183–187. <https://doi.org/doi:https://doi.org/10.29303/jgn.v4i2.235>
- Veloo, A., Perumal, S., & Vikneswary, R. (2013). Inquiry-based Instruction, Students' Attitudes and Teachers' Support Towards Science Achievement in Rural Primary Schools. *Procedia - Social and Behavioral Sciences*, 93, 65–69. <https://doi.org/doi:https://doi.org/10.1016/j.sbspro.2013.09.153>
- Vlassi, M., & Karaliota, A. (2013). The Comparison between Guided Inquiry and Traditional Teaching Method. A Case Study for the Teaching of the Structure of Matter to 8th Grade Greek Students. *Procedia - Social and Behavioral Sciences*, 93, 494–497. <http://dx.doi.org/10.1016/j.sbspro.2013.09.226>
- Wiyoko, T., & Teguh, R. (2014). Pengembangan Media Pembelajaran Fisika Modul Elektronik Animasi Interaktif Untuk Kelas XI SMA Ditinjau Dari Motivasi Belajar Siswa. *Jurnal Pendidikan Fisika*, 2(2), 11–15. <http://jurnal.fkip.uns.ac.id/index.php/pfisika/article/view/4670>
- Zahrudin, I.S., & Yuliati, Z.Q. (2021). Policy Analysis Of Implementation Of Minimum Competency Assessment As An Effort To Improve Reading Literacy Of Students In Schools. *Paedagogia: Jurnal Kajian, Penelitian Dan Pengembangan Kependidikan*, 12(1), 83–91. <https://doi.org/10.31764/paedagogia.v12i1.3925>