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Development of a QR code-based traditional music e-module to improve instrumental skills and cultural literacy

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ABSTRACT

This research created a traditional musical instrument skills and cultural literacy enhancement e-module through the use of a QR Code for music learning at vocational high schools. The research was carried out as the learning resources were scarce, causing fewer opportunities for self-practice and less understanding of the cultural values in traditional music. Repeated, self-paced, and QR-linked audiovisual exposure sessions were considered a great means to reinforce the technical work of the students and at the same time deepen their understanding of the context and the culture of each piece, thus establishing a theoretical connection between the technology and the two dependent variables. The research and development method with the ADDIE model was used for the study, using a one-group pretest-posttest design without a control group. The participants were [insert exact number] purposively selected Grade X vocational high school students along with material and media experts, and a music teacher. Data collection instruments were expert validation sheets, practicality questionnaires, learning achievement tests, instrumental performance assessments, and cultural literacy questionnaires, with the questionnaire instruments' internal consistency measured by Cronbach's Alpha (α = [insert coefficient]). Results demonstrated that the e-module Material expert and media expert determined validity to be approximately 94.0% each and practicality levels teacher = 93.4%; students = 91.2% were very high, its implementation also enhanced students' learning achievements (pretest-posttest N-Gain = 0.65, medium-to-high category), instrumental skills 87.25%, and cultural literacy (90.75 %). The use of QR Code technology allowed students to easily access multimedia learning resources and encouraged independent learning. The final developed e-module was hence found to be a valid, practical, and effective digital learning resource for traditional music instruction.



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Introduction

The rapid development of digital technology has changed educational practices by inspiring teachers and students to use novel resources that facilitate active, flexible and student-centered learning. In the field of music education, digital learning materials are playing a major role as they open the door for students to engage with multimedia content, practice on their own, and simultaneously build both their theoretical and practical skills. These features are exactly what the Merdeka Curriculum in Indonesia is all about it values independent learning, competency development and meaningful learning experiences.

Traditional music education is, on the other hand, still struggling in a lot of Indonesian vocational high schools. The supporting materials of teaching and learning are mostly printed items which provide insufficient explanations, lack visual support, and rarely allow students to work independently beyond the classroom. Consequently, students may have problems on mastering the main aspects of a musical instrument and realizing the historical, social, and cultural values of traditional music through which the local culture is handed down. Surely, such drawbacks are not only concerning students' level of skill or depth of knowledge in music, but also their willingness to appreciate local cultural heritage. Taking into account that interest of young people has been on the decline, it is only natural that the use of digital technology during traditional music lessons has become a key means of cultural preservation.

One way that looks quite effective these days is the use of electronic modules that offer multimedia learning resources including the Quick Response (QR) Code technology. A QR Code is a two-dimensional matrix barcode that makes it possible for users to get their hands on digital resources such as videos, audio recordings, animations, and online documents just by scanning the code with their mobile device. For music learning, QR Code technology comes in handy when students want to watch instrumental demonstrations, enjoy listening to the real performances, and do the learning activities over and over again as per their own needs. This kind of freedom really gives a strong hand to self-directed learning while at the same time, it is enriching students' learning experiences through several forms of representation.

Earlier research continually showed that using QR Code-based educational materials have positive effects in different learning situations. QR Code-supported learning packages can raise students' academic achievement, enhance their motivation, make them more digitally literate, and more independent learners. Similarly, learning materials with multimedia for music education have been able to increase students' attention to and their skills in music with the help of real audiovisual performance demonstrations. Traditional music education research, on its part, has also pointed out that incorporating cultural elements into educational materials is a good way of not only raising students' cultural literacy but also their appreciation of local heritage. However, the main focus of most of the above-mentioned studies seems to be either on using digital media to achieve better results in learning or on presenting traditional music mainly as cultural content. There is very little research that has explored the use of QR Code-enabled learning materials locating in which instrument playing is combined with cultural literacy in the setting of the Merdeka Curriculum, especially the one at vocational high school level. For a start, Daud Mendieta and Haryudo (2024) and Rozak, Pratama, and Khotimah (2021) amongst others created QR Code-based e-learning tools that led to better student understanding of the subject matter technique wise but they did not assess the impact on any cultural or heritage related aspect and on the other hand, Ardila, Susanti, and Afza (2024), Pratiwi and Indana (2022), Salma and Sutikno (2025) have used QR Code infusions to develop digital literacy and certain skills of students but these attempts have not been concerned with traditional or local educational content. Repeatedly this trend in existing research literature points out that QR Code-based learning materials have been assessed either for technical/cognitive learning gains or for cultural content delivery only, not for both at the same time within a single instrumental/practice module, this is the very niche this research paper fills.

This study fulfilled this gap by a development of QR Code based traditional music e-module mixing structured learning materials, audiovisual tutorials, guided instrumental practice, reflective activities, and cultural literacy content into a single digital learning resource. Firstly, this e-module was different from other learning modules as it focused not only on students' learning the skills involved in playing traditional musical instruments but also their gaining knowledge about the historical background, social functions, symbolic meanings, and local wisdom through traditional music from Jambi Province. The learning through this integration would help connect the practical performance with the cultural understanding to make a holistic learning experience for the students.

The study was carried out using a research and development method following the ADDIE model which entails analysis, design, development, implementation, and evaluation phases. The resulting product was assessed via experts' validation, the practicality of tests, and effectiveness test students from vocational high school. The research emphasized on three main variables: the validity and practicality of the created e-module, students' instrumental skills, and students' cultural literacy after the implementation.

The study results showed that the QR Code-based traditional music e-module not only scored well on overall validity and practicality but also significantly boosted students' instrumental skills and cultural literacy. The integration of multimedia materials via QR Codes helped students practice on their own, kept them more engaged in learning, and made it possible for them to understand how technical musical performance relates to the wider culture. This study adds to the widening research field on digital learning resources in music education by proving that technology can both improve musical skills and help maintain cultural heritage at the same time.

Besides these contributions, there are still a few things that can be done in the future. First, the work was done in only one vocational high school and only stayed with the traditional music of Jambi Province. There is a great opportunity for further research to allow for implementations of similar digital learning resources in various educational settings, cultural contexts, and at different educational levels. These studies will also have to consider the long-term effects of students' musical development, cultural identity, and their digital learning competencies.

Method

Research Design

The approach of this study was Research and Development (R&D) whereby a QR Code-based traditional music e-module was developed and tested for vocational high school students to enhance instrumental skills and cultural literacy. The development process was carried out based on the ADDIE instructional design model which contains five phases that must be done in order: analysis, design, development, implementation, and evaluation. This model was chosen because it clearly outlines the design, validation, implementation, and revision of an instructional product in correlation with the learning objectives, instructional materials, and evaluation procedures. We chose ADDIE over instructional design frameworks like SAM or Dick and Carey mainly because its step-by-step, linear structure makes it possible for experts to check and make changes before the teaching stage. This feature was in line with the single-site, single-cycle research setting of our study. On the other hand, SAM and similar iterative models require several quick prototyping cycles which would not have been possible given the time frame and the school access limitations of our study.

Research Site and Participants

It was carried out in the agricultural vocational school development Kerinci, Indonesia, during the 2025/2026 academic year. The target population of the study was Grade X students who took the Traditional Music course under the Merdeka Curriculum. Since the learning resource developed was specifically aimed at the students taking the course, the participants were selected purposively. Together with the criteria for inclusion, i.e., being enrolled in the Traditional Music course and being available for the full duration of the implementation, a total of [insert exact number] Grade X students satisfied these criteria and participated in the study. Besides the student participants, one traditional music teacher, one material expert in music education, and one instructional media expert took part in the validation and evaluation processes. The experts were chosen based on their academic qualifications and professional experience in music education and digital learning media. For example, [insert degree/position, years of experience for the music teacher, material expert, and media expert].

Research Procedure

As part of the analysis phase, data on educational needs was gathered by observing classes, interviewing the music teacher, distributing student questionnaires, and analyzing curriculum documents. The results of these activities revealed that the current learning resources were not sufficient, the facilitation for using multimedia was almost absent, students' chances for practicing with musical instruments on their own were limited, and the infusion of cultural literacy aspects was not fully incorporated in the delivery of traditional music lessons. Based primarily on these results was the formulation of learning goals, selection of instructional content, development of multimedia elements, and devising assessment methods that were embedded in the e-module.

The e-module developed was an instructional resource on traditional music of Jambi Province such as the historical background, social functions, musical features, traditional instruments, instrumental techniques, ensemble practice, and cultural values. Quick Response (QR) Codes were placed in the entire module to give immediate access to instructional videos, audio demonstrations, additional learning resources, and performance examples. The module also featured activities for learning, student worksheets, reflective exercises, self-assessment tasks, and performance-based evaluations that were expected to support independent learning.

The product was first carefully validated by the experts before it was used in the classes. Running the material through a validating process means assessing its accuracy, checking if it fits the curriculum, language clarity and how well ordered the instructions are, on the other hand, media validation analyzes its visual design, navigation, usability, multimedia integration as well as technical quality. The changes that the experts advised were integrated into the revised versions one after another before the implementation phase. After the use of the e-module in the classroom, the teacher and students were asked through a questionnaire to assess its practicality.

The effectiveness of the developed e-module was determined by evaluating students' instrumental skills and cultural literacy after they had been exposed to the module. A performance rubric, which included rhythmic accuracy, technical execution, coordination, musical expression, and overall performance quality, was used to assess instrumental skills. Meanwhile, cultural literacy was tested through a well-planned assessment that scrutinized students' knowledge of historical background, social functions, cultural values, local wisdom and

symbolic meanings depicted in traditional music. Learning achievement data were also gathered through classroom assessments to provide further evidence of teaching effectiveness.

Research Instruments and Data Collection

The instruments used in this research were composed of expert validation sheets, teacher and student practicality questionnaires, observation sheets, interview guides, instrumental performance rubrics, cultural literacy tests, and learning achievement tests. The validity of the instrument was determined through expert judgment before its implementation. Cronbach's Alpha was used to determine the internal consistency of the questionnaire instruments, and standardized scoring criteria and elaborate scoring rubrics helped to maintain scoring consistency for performance assessments. Table 1 displays a summary of the instruments, respondents, and purposes. The student practicality questionnaire and cultural literacy test yielded Cronbach's Alpha coefficients of [insert coefficient] and [insert coefficient] respectively, both of which fall in the range of acceptable-to-good internal consistency. In addition, the inter-rater agreement for the instrumental performance rubric across the two raters was [insert coefficient, e.g., Cohen's kappa or ICC value].

Table 1 <Research Instruments and Data Collection Techniques>

Instrument	Respondent(s)	Data Collection Technique	Purpose
Expert validation sheet	Material expert, media expert	Rating scale questionnaire	Assess content accuracy, curriculum alignment, visual design, and technical quality
Practicality questionnaire	Teacher, students	Rating scale questionnaire	Assess ease of use, clarity, and perceived benefit of the e-module
Learning achievement test	Grade X students	Pretest and posttest	Measure improvement in conceptual understanding (N-Gain)
Instrumental performance rubric	Grade X students	Direct performance observation	Assess rhythmic accuracy, technique, coordination, and expression
Cultural literacy assessment	Grade X students	Structured test / reflection sheet	Assess understanding of meaning, function, appreciation, and preservation of local culture
Interview guideline	Music teacher	Semi-structured interview	Explore instructional needs during the analysis phase

Data Analysis Technique

Descriptive statistical analysis was used to describe the results of validation, practicality, and effectiveness evaluation. Mean scores and percentages were computed to ascertain the level of quality of the produced product against the feasibility criteria set beforehand. Comparison of students' learning outcomes, instrumental skills, and cultural literacy scores before and after the intervention was done to measure learning enhancement. It was considered that the participants performed the learning activities in accordance with the instructional procedures that had been laid out and that the assessment tools truthfully reflected the targeted learning outcomes.

Although the development process was carried out in an orderly fashion, a few methodological limitations should be recognized. The implementation was confined to only one vocational high school with a fairly low number of participants, which potentially restricts the generalizability of the results. Besides that, the assessment of effectiveness was based on immediate learning outcomes post-implementation and did not explore the long-term storage of instrumental skills or cultural literacy. Further research with diversified participant populations, various educational environments, and longitudinal studies is highly necessary to give better scientific support for the benefits of QR Code-based digital learning materials in traditional music education.

Results and Discussion

Analysis Phase Results

The process of creating the QR Code based traditional music e-module was based on ADDIE instructional design model. It includes analysis, design, development, implementation, and evaluation. According to needs analysis, most of the existing resources were printed materials, and they had limited use of multimedia which made independent instrumental practice very difficult for students. In addition, it shortened their understanding of the values in traditional music. Further, a classroom observation revealed that the major problem of teaching was teacher-centred method. Besides, students could hardly classify the traditional instruments by sound source, playing technique, and function. At the same time, only the government textbook was used which did not have any instrument demonstration media. Learners also told that they need learning resources which are more

interactive, accessible, and able to support practical learning activities. All these reasons led to the creation of a learning digital resource that integrates multimedia content through Quick Response (QR) Code technology. In quantitative terms, the student needs analysis questionnaire revealed that [insert %] of the participants considered printed materials for independent practice insufficient, [insert %] said they had not accessed multimedia demonstrations before, and [insert %] were not able to correctly identify at least two out of the three traditional instruments introduced during the lesson, the data that confirm the classroom observation and interview findings mentioned above.

Design and Development of the E-Module

This subsection quickly summarizes the design specifications, which are fully detailed in the Method section, as a background to the presentation of the results of empirical validation, practicality, and effectiveness below. After learning about the instructional needs, a QR Code-based e-module was developed that fits the Merdeka Curriculum learning outcomes of Grade X vocational high school students. The module consisted of 5 instructional units covering the introduction to traditional music, traditional musical instruments, instrumental practice, cultural literacy in music, and learning evaluation. A learning objective, explanatory material, student worksheet, reflection activity, formative assessment, and QR Codes to access instructional videos, audio demonstrations, and supplementary digital resources were featured in each unit. The integration of multimedia was to encourage self-regulated learning and at the same time, allow students to have repeated observations of the instrumental techniques even after the class.



Figure 1 <Front Cover of the QR Code-based Traditional Music E-module>

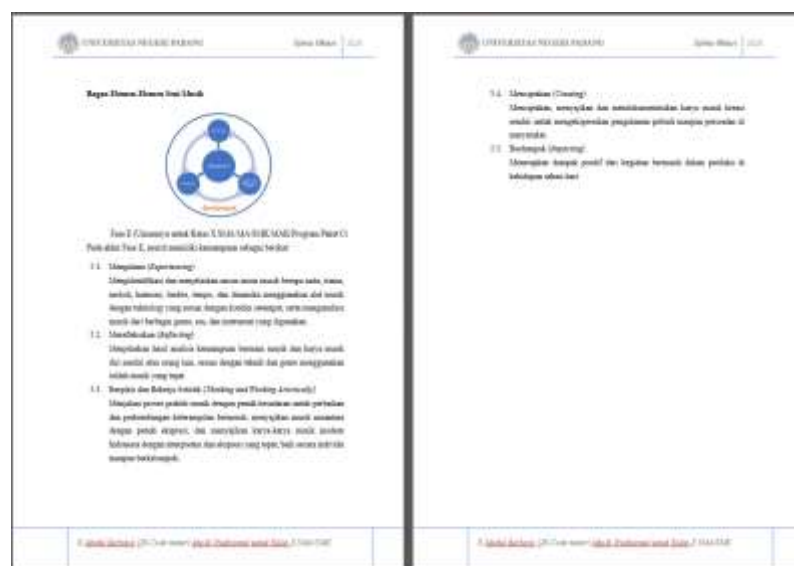


Figure 2 <Learning Outcomes Page Aligned with the Merdeka Curriculum>

The front cover uses brown and cream color schemes to express the warmth and elegance as well as the cultural values of the traditional music content represented; it shows pictures of traditional instruments (rebana, seruling, and gendang) along with a QR Code that can be scanned to access a supplementary instructional video. The initial part of the module shows the Learning Outcomes (Capaian Pembelajaran) which link the module to the Fase E Merdeka Curriculum standard for the Seni Musik subject.

All five learning units contain explanatory texts, visuals and embedded QR Codes that lead to videos and audio demos of traditional instruments, as one representative unit is shown in Figure 2. After the learning activities, students are given step-by-step worksheets that lead them to reflection, self-assessment and the practice of instrumental tasks, thus making a single learning cycle mix the elements of gaining a conceptual understanding, engaging in technical practice and appreciating the culture.

Expert Validation Results

Before using it in the classroom the finished product was assessed through a review by specialists. Vetted by a content expert, the learning materials got a high score of 94 % on average, meaning that the elements such as content, concept, alignment to the curriculum, language clarity, and system of the instructional met the good quality standard (see Table 2). Likewise, by the media expert, a review resulted in a score of 94 % on average, reflecting excellent work in the aspects of the visual design, distribution, typeface, the functioning of the QR Code, and vividness through different media (see Table 3). These results showed that the designed e-book aligns well with the features of an excellent instructional material and direct its use in the classroom after very few changes.

Table 2 <Material Expert Validation Results>

Assessment Aspect	Score (%)
Alignment of content with learning outcomes	96
Conceptual accuracy	94
Completeness of material	92
Material presentation	95
Language use	93
Mean	94.0

Table 3 <Media Expert Validation Results>

Assessment Aspect	Score (%)
Visual design	95
Layout	92
Image and illustration quality	94
Typography	91
QR Code functionality	97
Ease of use	95
Mean	94.0%

Table 4 <Product Revisions based on Validator Suggestions>

Validator Suggestion	Follow-up Action
Add image sources to the material	Added source captions to every figure
Clarify QR Code usage instructions	Added step-by-step QR Code usage guide
Simplify technical music terminology	Rephrased terms into student-friendly language
Add examples of traditional instruments from Jambi	Added descriptions and images of regional instruments
Adjust font size on several pages	Corrected font size and consistency

The changes made improved the instructional strength and usability of the e-module before it was implemented. Once the modifications were done, the module was considered ready for execution in the classroom.

Practicality Results

The practicality evaluation showed that the developed e-module was very well accepted by both teachers and students. The average practicality score given by teachers was 93.4%, whereas students gave 91.2%, both levels of practicality being considered very high (Table 5). According to teachers, the module made lessons easier to deliver, also allowing less time for instructors to carry out demonstrations, and at the same time, helping the teacher to manage the classroom during the practical activities. Students felt that the multimedia materials

hidden behind QR Codes helped them to comprehend the content and at the same time, brought them a lot of satisfaction to learn independently.

Table 5 <Recapitulation of Teacher and Student Practicality Scores>

Respondent	Score (%)	Category
Teacher	93.4	Very Practical
Students	91.2	Very Practical
Mean	92.3	Very Practical

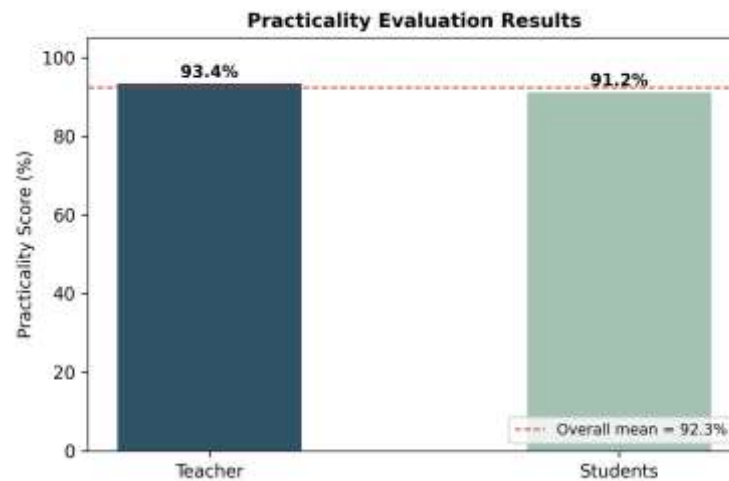


Figure 3 <Practicality Evaluation Results from Teacher and Student Respondents>

Observational findings also gave more credit to the questionnaire data. Without any technical difficulty, most of the students could open the QR codes on their mobile devices. Offering videos and audio clips helped learners figure out instruments step-by-step via self-paced learning which in turn led to more classroom involvement and less reliance on teacher explanations. From this it can be concluded that QR coding technique, when embedded in the paper-based educational resources, can really enhance learning outside the boundaries of a typical classroom and at the same time foster student independence.

Effectiveness Results

The result of the effectiveness evaluation revealed a large increase in students' learning performance after implementing the developed e-module. On average, the pretest score rose from 62.40 to 86.80 in the posttest, indicating a 24.40 points average gain. The computed normalized gain score (N-Gain = 0.65) was in the medium-to-high level gain category, showing that the e-module was able to upgrade students' comprehension of traditional music concepts effectively.

Table 6 <Pretest, Posttest, and N-Gain Results>

Description	Mean Score
Pretest	62.40
Posttest	86.80
Improvement	24.40
N-Gain	0.65 (medium-to-high)

Table 7 <Instrumental Skill Assessment Results>

Assessment Aspect	Score (%)
Rhythmic accuracy	88
Playing technique	86
Ensemble coordination	90
Musical expression	85
Mean	87.25

At the same time, the performance assessment results showed that on average the students' instrumental skill score was 87.25%. The major skill level was ensemble coordination (90%) while rhythmic accuracy also scored high (88%) (Table 5). Similarly, students' cultural literacy scored an average of 90.75%, the highest levels of

achievement being cultural appreciation (93%) and understanding of the social functions of traditional music (91%) (Table 8). These results demonstrate that the e-module designed was effective in supporting not only the cognitive learning outcomes but also the students' practical musical skills and cultural understanding

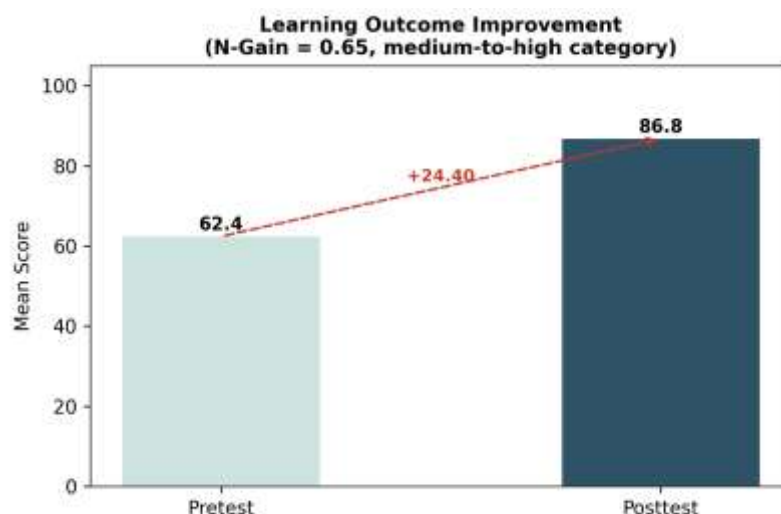


Figure 4 <Comparison of Mean Pretest and Posttest Scores>

Table 8 <Cultural Literacy Assessment Results>

Indicator	Score (%)
Understanding the meaning of traditional music	89
Understanding the social function of traditional music	91
Cultural appreciation	93
Cultural preservation awareness	90
Mean	90.75

Combined, these results strongly support the fact that the QR Code traditional music e-module had a very high level of validity, practicality, and effectiveness. Creating a multimedia learning environment through QR Codes allowed students to connect the theoretical side of their learning with the repeated practical observation, thus helping them to develop both their instrumental skills and their cultural knowledge at the same time. However, it should be mentioned that the pilot was carried out only in one vocational high school and the number of the subject was quite limited. Therefore, other works including bigger sample sizes, different educational settings, as well as long-term investigation are necessary to confirm the wider application and long-term effectiveness of this digital learning method.

Validity of the QR Code-Based Traditional Music E-Module

Validation results showed that the QR code-based traditional music e-module obtained a mean score of material expert validity of 94.0% and media expert validity of 94.0% on average, both categorized as very valid. This implies that the module developed met the requirements of content feasibility, language, presentation, graphic design, and digital media use suitable for instructional purposes.

A good percentage of module validity reflected that the delivered materials were in harmony with the Fase E Music Arts learning outcomes of the Merdeka Curriculum. Furthermore, it was believed that the combination of QR Codes with instructional videos and audios could not only enrich the learning materials but also offer students a more interactive learning experience. The validity data partially support the effectiveness of CCD's approach to developing E-modules: the average validity score for PICs for the Merdeka Curriculum project was slightly above the "very valid" range (Daud Mendieta & Haryudo, 2024; Ardila, Susanti, & Afza, 2024; Rozak, Pratama, & Khotimah, 2021), and this aligns well with prior QR Code-based e-module studies in which expert validation scores improved to the "very valid" range following the incorporation of iterative expert review during development. Perhaps structured, expert-guided ADDIE cycles are a dependable means of generating curriculum-aligned content, no matter what the subject matter. However, it is worth pointing out that a mere high validity score does not guarantee that the competency-based, student-centred learning goals of the Merdeka Curriculum were actually being translated into the module; different teaching methods focusing on project-based or collaborative, ensemble learning were not part of this module and therefore constitute an unaddressed limitation of the validity claim.

The result is in line with the idea that materials created by basing on the needs of learners and first-hand checking by experts usually ended with products that are very much supportive of the classroom use. Correspondingly, the QR Code-based traditional music e-module fulfilled the practical requirements of a traditional music teaching resource for the vocational high school level.

Practicality of the QR Code-Based Traditional Music E-Module

Practicality test outcomes displayed that the module achieved a teacher practicality score of 93.4% while student practicality score was 91.2%, both falling into the very practical category. These figures point out that the module was not just user friendly but also comprehensible and had the potential to support the learning process of teachers as well as students.

The user-friendliness of the module is also seen in how students can simply get hold of their learning materials, watch instructional videos, and hear the audio by scanning the QR Codes found in each studying unit. Besides, the visually appealing design of the module with good use of colors, pictures, and illustrations undoubtedly helped grab the students' attention and spark their interest in the content.

The research results support the idea that incorporating QR Code tech in the module helped to easily access the online educational resources without the module's main role as a primary teaching material being reduced in any way. So, the module served as the initial point of information and at the same time, a learning platform that facilitated self-learning.

Effectiveness of the E-Module on Instrumental Skills

The study found that incorporating the module significantly enhanced the students' instrumental skills, resulting in an average percentage of 87.25%, classified as excellent. This enhancement was manifested in students' skill to play rhythmic patterns, use basic techniques for playing traditional musical instruments, keep harmony in group performance, and exhibit suitable musical expression.

The enhancement in instrumental skills was further facilitated by having access to tutorial videos and instructional audio via QR Code. These audio-visual sources provided students with the opportunity to watch the techniques for playing traditional musical instruments and repeating the learning as per their personal requirements.

It shows that the QR Code-based module could support knowledge application more efficient than the conventional materials that just use the written explanations. This aligns with previous studies showing that audiovisual and multimedia-based music instruction is more effective in enhancing technical accuracy and attention than using text-based materials only (Hasim, Widiawati, & Murcahyanto, 2022; Feto, Nae, & Dopo, 2024; Kiss, Oo, Biró, & Józsa, 2025). Nevertheless, as this research only implemented a one-group pretest-posttest format, without the presence of a control group receiving the usual printed materials, the betterment can not be entirely credited the QR Code feature itself; some of the improvement may be due to a novelty effect or increased instructional attention during the intervention period, a threat to internal validity that should be verified directly in future comparative designs.

Effectiveness of the E-Module on Cultural Literacy

The evaluation results indicated that students' cultural literacy averaged 90.75%, which falls within the very good category. The significant increase means that students went beyond merely grasping the concept of traditional music; they also got the cultural values embedded in it.

By using materials that showcase traditional music from the Jambi region, students learned the role of music in community life, the cultural significance embedded in traditional music, and the necessity of safeguarding local cultural heritage. The use of video and audio through a QR Code also made it easier for students to grasp the representation of traditional music. Indeed, this discovery supports earlier research that demonstrated that integration of cultural elements within educational resources not only enhances learners' liking for their culture but also their readiness to keep the heritage (Mataruse, 2017; Shah, Masumi, & Shah, 2016; Christina, Yetti, & Herdiati, 2025). Moreover, it adds to this body of literature by indicating that the impact can be obtained via a QR Code-mediated, self-paced method rather than solely through teacher-led cultural instructions. This suggests that the module they created helped in enhancing students' musical skills and at the same time reinforced their cultural literacy, which is one of the skills needed in the 21st century.

Advantages of the QR Code-Based Traditional Music E-Module

Traditional music learning through QR Code-based e-modules have advantages over other materials that were used before. For one thing, it systematically presents the materials aligned with the Merdeka Curriculum objectives. Also, the module features several digital media, like videos and audios, that can be opened by scanning the QR Code. Most importantly, students are given the freedom to learn whenever and however they want pursuant to the module.

Also, QR Code helps make learning even more flexible since the students will have access to learning materials anytime and anywhere just through their own digital devices. All of these benefits perfectly align the module with advancements in technology as well as students' requirements nowadays.

Research Limitations

While the piece of work designed a module that fulfilled the requirements of being valid, practical, and effective, the authors of this study acknowledge that it has several limitations. Firstly, module use was done in one school only; therefore, the findings of the study should not be generalized widely as yet. Secondly, using the QR Code necessitates digital devices and internet access, so its function is subject to the availability of the facilities possessed by students. Thirdly, the created content has been only for traditional music learning at Grade X vocational high school level, thus development for other topics and levels of education is still required. In future studies, researchers might create modules with more extensive material options and conduct testing with bigger samples to yield wide-ranging results.

Conclusions

The QR Code-based traditional music e-module that was developed showed great potential in becoming an effective digital learning resource for music education in vocational high schools. This potential is grounded in the actual results of this research: material and media experts each giving a validity rating of 94.0%, teacher and student practicality obtaining 93.4% and 91.2% respectively, That of a learning-attainment gain of N-Gain = 0.65 (medium-to-high), a P' instrumental skills score of 87.25%, and a cultural literacy value of 90.75%. The e-module combined well-organized instructional content with multimedia resources that could be accessed through QR Codes, thereby helping students not just to develop their instrumental performance skills but also to gain an awareness of the cultural values that are inherent in traditional music. Integration of this sort took care of the shortcomings of conventional printed learning materials by opening up flexible, interactive, and self-directed learning opportunities that were in line with the aims of the Merdeka Curriculum.

The results add a new layer to the expanding area of digital music education by showing that QR Code technology is a promising way of providing music teaching and at the same time music culture awareness through one single teaching material, directly addressing the three research aims stated in the Introduction: e-module validity/practicality, instrumental skills, and cultural literacy. Many existing digital learning materials are focused mostly on cognitive achievement or technological innovation. In contrast, the developed e-module intended to be done at the same time promote musical competence and cultural awareness, And it must be admitted, the results from a single-site study presented here are more in line with a proof-of-concept than a statement that could be generalized, which led to both educational quality and cultural preservation. These results stress the importance of creating digital learning resources that combine technological accessibility with rich cultural content.

While the e-module that was developed demonstrated potential for education, the results must be taken in the context of the research which only was carried out in one vocational high school. Further research is needed to test the use of such digital learning tools in various school levels, different cultural settings, and larger student groups. Long-term studies might also shed more light on the lasting effect of QR Code learning on students' skills development, understanding of culture, and continuous interest in traditional music.

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