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Development of an Audio-Visual-Based Algebra E-Module Oriented Toward Auditory and Visual Learning Styles

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Abstract

The restricted use of mathematical learning media, which is still dominated by traditional teaching materials and has not been able to accommodate variations in students' learning styles, notably auditory and visual, is the driving force behind this study. This condition makes it difficult for some students to comprehend abstract algebraic content. Thus, the goal of this research is to create a viable audio-visual E-Module that can accommodate both visual and aural learning modalities. Research and development (R&D) using the ADDIE model—which comprises the phases of analysis, design, development, implementation, and evaluation—is the research methodology employed. Expert validators and 38 seventh-grade students from SMP Plus Matholi'ul Anwar participated in the feasibility test as study subjects. Validation sheets and student answer questionnaires with a modified Likert scale were utilized as data gathering methods. According to the study's findings, the created E-Module was deemed legitimate with an average validity score of 3.75. Furthermore, the average score for the feasibility test was 6.51, which is in the extremely practicable range. As a result, the created audio-visual-based E-Module is thought to be suitable for usage as a mathematics learning tool in algebra content and can assist students' comprehension in accordance with their visual and auditory learning preferences.

Keywords: E-Module, audio-visual, learning styles, algebra

1. Introduction

One of the subjects that is crucial for the development of logical, analytical, methodical, and critical thinking abilities is mathematics. The NCTM claims that mathematics include reasoning skills, problem-solving techniques, communication, and linkages between ideas in addition to numbers and computations. Therefore, mathematics learning should facilitate students in constructing knowledge meaningfully through contextual and relevant learning experiences (Farisy et al., 2026). In the context of modern education, the development of digital technology has transformed conventional learning into technology-based learning, requiring teachers to utilize innovative learning media that are aligned with the Merdeka Curriculum (Sari & Kurniawati, 2020).

Algebra is one of the key subjects taught in junior high school mathematics classes. Algebra learning focuses on introducing abstract concepts such as variables, coefficients,

constants, and algebraic operations, which serve as the foundation for advanced mathematics such as calculus, statistics, and analytic geometry (Wati et al., 2026). However, algebra is often considered difficult by students due to its abstract and symbolic nature, which can lead to misconceptions and difficulties in problem-solving (Nurmaidah & Lubis, 2026). Therefore, learning media are needed to help bridge abstract concepts into more concrete forms.

Prior research has demonstrated that incorporating digital learning resources can enhance students' learning results in mathematics. The development of E-Modules has proven to be effective in supporting independent learning, increasing student engagement, and facilitating conceptual understanding through the integration of multimedia elements such as text, images, audio, and video (Arifin et al., 2023; Hartatiana & Wardani, 2024). In addition, platforms such as Heyzine enable the transformation of conventional modules into more engaging interactive flipbooks that can be accessed across various devices. The use of audio-visual media has also been proven to enhance students' motivation and understanding, particularly in abstract mathematical topics (Isma et al., 2022; Rasul et al., 2022).

Most existing studies focus only on the general development of E-Modules without considering students' learning styles. In fact, learning styles particularly visual and auditory greatly influence how students receive and process information. Research on VAK (Visual, Auditory, Kinesthetic) learning styles shows that the alignment between instructional media and students' learning styles can enhance learning effectiveness (Nirwana et al., 2021). However, there is still limited research that integrates audio-visual-based E-Modules specifically designed to accommodate visual and auditory learning styles in algebra learning.

This study develops an audio-visual-based algebra E-Module designed to accommodate visual and auditory learning styles. The integration of visual components (images, animations, and diagrams) with auditory components (narration and audio explanations) is expected to provide a more comprehensive learning experience. This approach is relevant in supporting differentiated learning within the Merdeka Curriculum, where instructional strategies should align with students' characteristics (Evendi et al., 2023). Improving students' conceptual grasp and enthusiasm to learn algebra is crucial, especially in schools that continue to use traditional teaching techniques.

Preliminary observations at SMP Plus Matholiul Anwar revealed that almost 60% of pupils scored below the Minimum Mastery Criteria (KKM), indicating that students struggle to master algebraic topics. Additionally, because of boring teaching strategies and little use of interactive learning resources, students are more likely to be passive and less involved in their education. This condition shows a disconnect between the existing teaching techniques, which are still dominated by traditional approaches, and the need for creative, technology-based learning medium.

The goal of this project is to create an audio-visual algebra E-Module that caters to both visual and aural learning preferences. The study's specific goals are to: (1) ascertain the produced E-Module's validity level; and (2) ascertain the E-Module's viability in promoting mathematics learning. It is anticipated that the created E-Module will be able to function as a cutting-edge teaching tool that improves students' comprehension of algebraic ideas and facilitates the evolution of digital-based mathematics education.

2. Methods

The goal of this research and development (R&D) project is to create an algebra E-Module with an audio-visual component. This approach is used to methodically create learning products and assess their viability (Judijanto et al., 2024). Because it is methodical and permits ongoing assessment, the study design refers to the ADDIE model, which comprises the phases of Analyze, Design, Development, Implementation, and Evaluation (Hidayat & Nizar, 2021; Rustandi & Rismayanti, 2021; Winaryati et al., 2021).

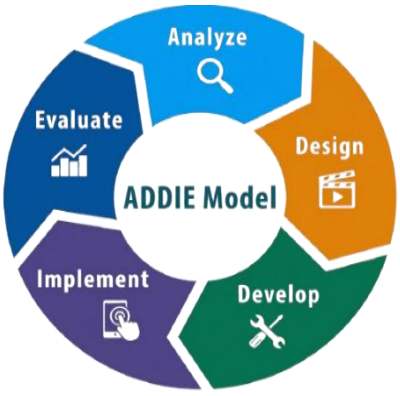


Figure 1. ADDIE Procedure. Source: (Mdodana-Zide, 2024)

The subjects of this study were seventh-grade junior high school students as users of the developed E-Module. The implementation stage involved 38 students of class VII B at SMP Plus Matholi'ul Anwar. In addition, this study involved expert validators to assess the feasibility of the product before implementation. The validators consisted of two experts: (1) Naning Kurniawati, a lecturer in Mathematics Education at Universitas Nahdlatul Ulama Sunan Giri Bojonegoro, as a material expert, and (2) Melin Ayu Ighfir Alaina, a mathematics teacher at SMP Plus Matholi'ul Anwar, as a media practitioner. The validators were selected based on several criteria, including: (1) having a relevant academic background in mathematics education, (2) having teaching experience of at least 3–5 years, and (3) having experience in developing or using instructional media in learning (Amalia et al., 2022).

The instruments used in this study consisted of validation sheets and student response questionnaires. The validation sheet was developed based on several aspects, namely physical appearance, presentation, material, language, audio components, visual components, and usefulness. The instrument consisted of 28 items distributed across these aspects, with each item measured using a 4-point Likert scale ranging from 1 (very poor) to 4 (very good). The preparation of the instrument was based on theories of instructional media evaluation and relevant previous studies. Furthermore, the instrument was validated through expert judgment (content validity) by the validators to ensure that each item was appropriate and relevant to the aspects being measured. Meanwhile, the student response questionnaire was used to determine the attractiveness, ease of use, and suitability of the media with students' learning

styles, and was complemented with suggestions as qualitative data on product quality (Ma'wa, 2024).

The five steps of the ADDIE model analysis, design, development, implementation, and evaluation are used in this study's research process. The design step plans the framework of the audio-visual-based E-Module after the analysis stage identifies the demands and characteristics of the pupils. While implementation is carried out through trials in the learning phase, the development step turns the design into a product. The evaluation stage seeks to determine the product's quality and make changes to provide the best possible E-Module.

The data analysis technique uses both quantitative and qualitative approaches. Quantitative data were obtained from expert validation and student response questionnaires, which were analyzed using a Likert scale of 1–4 to assess the validity and feasibility of the E-Module (Ma'wa, 2024). The scores obtained were averaged to determine the product assessment category. Meanwhile, qualitative data in the form of suggestions and comments were analyzed descriptively as material for improvement, so that the feasibility of the E-Module in mathematics learning could be determined (Jannah, 2025).

3. Result and Discussion

An audio-visual-based mathematics E-Module targeted at auditory and visual learning styles is the result of this project. Students' comprehension of the algebra content in the E-Module is improved by the use of text, graphics, animations, instructional videos, and audio explanations. The results of this study are presented based on the stages of the ADDIE model, which include Analyze, Design, Development, Implementation, and Evaluation.

At the Analyze stage, it was found that students experienced difficulties in understanding algebraic concepts, especially in abstract operations. In addition, students have different learning styles, particularly auditory and visual, which are not fully accommodated by conventional learning media.

At the Design stage, the E-Module was planned by integrating audio-visual elements such as instructional videos, narration, animations, and structured materials to support students' learning styles.

The researcher created an E-Module throughout the development phase by taking into account the material's methodical organization and visual elements. An eye-catching cover and a concept map that attempts to give a summary of the content are included in the first display. This design is focused on visual and auditory learning modes and is adapted to the traits of junior high school pupils.

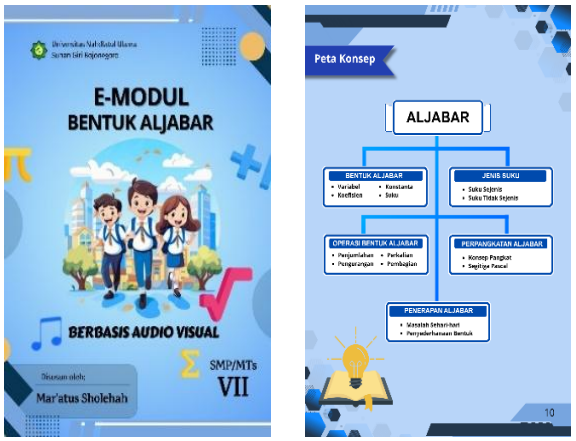
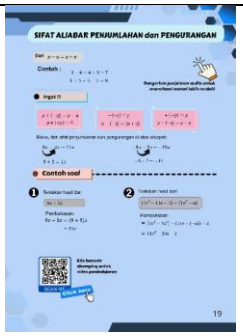
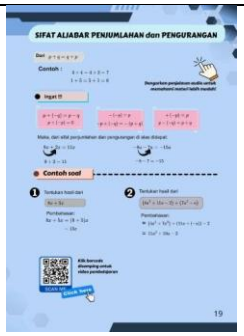
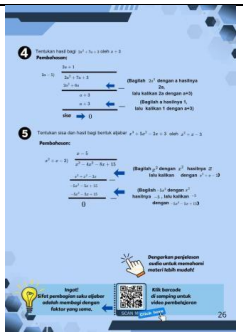
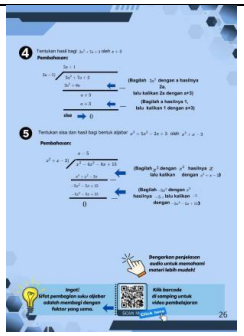


Figure 2. E-Module Display

Based on Figure 2, the E-Module cover presents the module identity, educational level, and engaging illustrations to increase students' learning interest. Meanwhile, the concept map displays the structure of algebra material systematically, including algebraic forms, types of terms, arithmetic operations, exponents, and their applications in daily life. This visual presentation helps students understand the relationships between concepts and facilitates them in learning the material in a structured manner.

As part of the product refinement process, revisions to the E-Module were carried out based on suggestions from validators. Improvements were made in several aspects, such as the placement of answers that was previously not systematic, correction of algebraic operation writing to align with mathematical conventions, and the presentation of division using clearer fraction bars. These improvements aim to enhance the clarity of the material and minimize students' misconceptions. A comparison before and after revision shows an improvement in the quality of material presentation, both in terms of conceptual accuracy and visual appearance, making the E-Module easier to understand and more suitable for use in learning.

Table 1. Revision Results

Improvements	Before Revision	After Revision
1. Placement of answers below the questions.		
2. $p + (-q) = -(p + q)$		
3. Division should use a fraction bar $2a - 5$		

To facilitate access to the developed E-Module, the researcher added a barcode that can be scanned using digital devices such as smartphones. This barcode functions as an alternative distribution medium, allowing students to easily access the E-Module anytime and anywhere.

Figure 3. Heyzine E-Module Barcode

Based on the figure, the displayed barcode is directly linked to the developed audio-visual-based E-Module. The use of this barcode supports the integration of technology in learning and enhances the practicality of media distribution. With this feature, students can quickly access the material without going through complicated processes, making learning more efficient and flexible.

1. Media Validation Results

To interpret the validation results, the criteria for the validity of learning media were adopted from Amalia et al. (2022), as presented in Table 2.

Table 2. Validity Criteria

Average Score ($\bar{X}$)	Category
$3{,}2 < \bar{X} \leq 4{,}00$	Very Valid
$2{,}50 < \bar{X} \leq 3{,}25$	Valid
$1{,}75 < \bar{X} \leq 2{,}50$	Less Valid
$1{,}00 < \bar{X} \leq 1{,}75$	Not Valid

The E-Module has a very high level of validity, according to the validation results from two validators. The following table summarizes the validation results:

Table 3. Average Media Validation Results

Validator	Average Score	Category
Validator I	3,77	Very Valid
Validator II	3,73	Very Valid
Average	**3,75**	**Very Valid**

According to the data, the average score was 3.75, which is considered "very valid." This shows that the E-Module satisfies the requirements for language, design, content, and audio-visual elements. However, minor revisions were still made, particularly in the writing of mathematical symbols and the presentation of concepts to ensure greater clarity and adherence to proper conventions.

2. Feasibility Test Results

The feasibility level of the E-Module was determined based on the student response questionnaire using a Likert scale. The interpretation of the average score refers to the feasibility criteria proposed by Amalia et al. (2022), as shown in Table 4.

Table 4. Feasibility Criteria

Average Score ($\bar{X}$)	Category
$3,2 < \bar{X} \leq 4,00$	Very Feasible
$2,50 < \bar{X} \leq 3,25$	Feasible
$1,75 < \bar{X} \leq 2,50$	Less Feasible
$1,00 < \bar{X} \leq 1,75$	Not Feasible

The feasibility test results were obtained from a questionnaire filled out by 38 students after using the E-Module.

Table 5. Media Feasibility Test Results

Number of Students	Number of Items	Total Score	Average	Category
38	20	2598	3,42	Very Feasible

The E-Module is classified as very feasible with an average score of 3.42. Regarding the media's appearance, usability, and its ability to support students in understanding mathematical concepts, students responded positively.

The high validity of the developed E-Module can be attributed to its systematic organization of content, alignment with curriculum objectives, and the integration of appropriate audio-visual elements. The material is presented in a structured and logical sequence, which enables students to understand algebraic concepts progressively. In addition, the clarity of language, consistency of design, and the use of relevant examples contribute to the overall quality of the media. These aspects support the high validation results obtained from experts.

The feasibility of the E-Module is also influenced by the effective use of audio elements that support students' learning process. Audio explanations help students, especially those with auditory learning preferences, to better understand mathematical concepts that are often abstract. This finding is consistent with the Cognitive Theory of Multimedia Learning proposed by Mayer, which explains that learning becomes more effective when information is delivered through both auditory and visual channels.

Furthermore, the use of visual elements such as images, diagrams, and animations plays an important role in enhancing students' conceptual understanding. Visual representations reduce the level of abstraction in algebra and help students identify relationships between concepts more easily. This supports Dual Coding Theory, which states that the combination of visual and verbal information can improve memory and understanding.

The developed E-Module is also appropriate for students' characteristics, particularly junior high school students who tend to prefer interactive and visually engaging learning

media. The integration of audio-visual components accommodates different learning styles, making the learning process more inclusive and effective.

The results of this study are in line with previous research stating that audio-visual-based learning media can improve students' understanding of mathematical concepts and their interest in learning (Afsari et al., 2021). In addition, the use of interactive E-Modules has been proven to increase student engagement in the learning process (Safitri et al., 2023). Other studies also show that digital media aligned with students' learning styles can enhance learning effectiveness (Siloto, 2023). Similarly, Sarumaha et al. (2022) emphasized that the combination of text and visuals is more effective than text alone in the learning process.

This study has several limitations. First, an effectiveness test to measure improvements in students' learning outcomes has not yet been conducted. Second, the material developed is limited to algebra, and the research subjects were drawn from only one school. Additionally, the use of the media still depends on an internet connection, which may become a constraint under certain conditions.

It is advised that future studies use experimental techniques to assess how well the E-Module affects students' learning outcomes. Furthermore, the development of the media can be expanded to other mathematical topics and involve a broader range of participants. Future studies may also focus on developing E-Modules that can be accessed offline and accommodate a wider variety of learning styles to make them more comprehensive.

4. Conclusion

The validity level of the developed media falls into the very valid category, according to the findings of the research and development of the audio-visual-based E-Module conducted via the stages of the ADDIE model. This shows that the E-Module is appropriate for use in the learning process since it satisfies the requirements in terms of content, presentation, language, and design. Additionally, based on students' comments, the feasibility level is classified as very feasible, meaning that the media may pique students' interest in learning, is simple to use, and aids in their comprehension of the subject matter, particularly abstract ideas like mathematics. Because it combines text, images, audio, and video to accommodate both auditory and visual learning styles, the audio-visual-based E-Module not only satisfies validity requirements, according to experts, but it is also suitable for use in education, making learning more engaging and meaningful.

5. Acknowledgements

The author would like to sincerely thank everyone who helped carry out this study, particularly the academic supervisor, the school administration, the instructors and students who took part as research subjects, and the family and coworkers who offered encouragement and moral support. The findings of this study are expected to have a positive impact on the advancement of mathematics education.

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