Tsaqila Jurnal Pendidikan dan Teknologi [TJPT]
Vol 6 Nomor 1 July 2026, hal: 148-171
ISSN: 2807-6273

Development of AVooks (Audio-Visual Books) Based on the Flipped Classroom Model to Enhance Learning Independence and Self-Efficacy among Students with Physical Disabilities

Venissa Dian Mawarsari[1*], Martyana Prihaswati[2], Eko Andy Purnomo[3], Abdul Aziz[4], Iswahyudi Joko Suprayitno[5]

[1,2,3,4,5]Universitas Muhammadiyah Semarang

[1]venissa@unimus.ac.id, [2]martyana@unimus.ac.id, [3]ekoandy@unimus.ac.id, [4]abdulaziz@unimus.ac.id
[5]iswahyudijoko@unimus.ac.id

Abstract

This study aimed to develop and evaluate the effectiveness of AVooks (Audio-Visual Books) based on the flipped classroom model in enhancing the learning independence and self-efficacy of university students with physical disabilities in the Multimedia Mathematics Learning course. AVooks is an accessibility-oriented learning medium that integrates text, audio narration, visual tutorials, and interactive navigation within a Learning Management System (LMS), enabling students to learn independently according to their individual learning pace and physical conditions. This study employed a Research and Development (R&D) approach using the ADDIE model. The participants were two university students with physical disabilities characterized by upper- and lower-limb deformities who were able to walk independently without using wheelchairs or other mobility aids. Data were collected using validated learning independence and self-efficacy questionnaires administered over seven learning sessions and analyzed using descriptive analysis, Achievement Percentage, and Normalized Gain (N-Gain). Expert validation indicated that AVooks was highly feasible for implementation, with an average score of ***3.56****. The results showed that the Achievement Percentage of learning independence increased from* ***45.00%*** *to* ***91.60%****, with an N-Gain score of* ***0.85*** *(high category). Likewise, the Achievement Percentage of self-efficacy increased from* ***41.60%*** *to* ***93.40%****, with an N-Gain score of* ***0.89*** *(high category). These findings indicate that integrating AVooks with the flipped classroom model provides an accessible and adaptive learning environment that effectively promotes learning independence and strengthens students' confidence in completing academic tasks. This study contributes to the advancement of inclusive higher education by demonstrating the potential of accessibility-oriented digital learning media to support university students with physical disabilities.*

Keywords: Flipped Classroom, Inclusive Learning, Learning Independence, Self-Efficacy, Physical Disabilities.

1. INTRODUCTION

Inclusive higher education requires learning systems that not only emphasize academic achievement but also support the holistic development of all students, including students with disabilities (Tamba Jefri, 2016; Harahap et al., 2019; Puspitosari et al., 2022). Among various disability groups, students with physical disabilities continue to encounter barriers related to accessibility, mobility, and active participation in learning activities (Winarto, 2017; Puspitosari et al., 2022; Gani & Wijaya, 2023). These barriers often reduce learning engagement and may negatively affect students' learning independence and self-efficacy (Ghaznavi et al., 2021; Syarief et al., 2022).

In this study, the participants were university students with physical disabilities characterized by upper- and lower-limb deformities. Although they were able to walk independently without using wheelchairs or other mobility aids and had no cognitive impairments, their motor limitations affected activities requiring fine motor coordination. These limitations made operating computers, using multimedia software, and completing repetitive digital tasks more challenging. Consequently, they often required more time to complete learning activities and experienced lower confidence in accomplishing academic tasks independently.

These challenges are particularly evident in the Multimedia Mathematics Learning course, which requires students not only to understand mathematical concepts but also to develop technology-based instructional media (Kurnia, 2018; Taufik & Rahaju, 2021; Gani & Wijaya, 2023). Students are expected to create instructional videos, design interactive multimedia, and utilize various digital authoring applications. Such learning activities require intensive interaction with computers, precision, and motor coordination. For students with physical disabilities, these demands may increase dependence on others and reduce confidence in completing learning tasks independently (Winarto, 2017; Satyani et al., 2018; Winarsih et al., 2019; Widajati et al., 2022; Khotijah et al., 2023).

Self-efficacy is a key determinant of academic success because it reflects students' beliefs in their ability to complete academic tasks successfully (Odabaş & Kahramanoğlu, 2023). In mathematics education, higher self-efficacy has been associated with better mathematical representation, persistence, and learning outcomes (Pikk et al., 2025). Likewise, learning independence has become an essential competency in twenty-first-century education, requiring students to regulate their learning, manage study time, and evaluate their own learning progress (Amer, 2022; Ayub et al., 2025). Accessible technology-enhanced learning environments can support these competencies by allowing students to learn at their own pace, revisit learning materials repeatedly, and develop greater confidence through independent learning experiences.

One instructional approach that accommodates these needs is the flipped classroom model. In this approach, students study learning materials before attending class, while face-to-face sessions are devoted to discussion, collaboration, and problem-solving activities (Widajati et al., 2022; Astuti et al., 2024). Previous studies have reported that flipped classrooms enhance learning independence by encouraging students to prepare before class. Moreover, the flexibility of asynchronous learning enables students with physical disabilities to access learning materials repeatedly according to their physical conditions, thereby increasing classroom participation and strengthening self-efficacy (Alan & Yurt, 2024).

Despite these advantages, implementing flipped classrooms effectively requires accessible learning media. Existing digital books, e-books, and multimedia learning applications generally focus on content delivery and provide limited accessibility features for students with physical disabilities. Furthermore, text, audio, and video resources are often presented separately, requiring students to switch among multiple applications during learning, which may reduce learning efficiency and independence. To address these limitations, this study developed AVooks (Audio-Visual Books), an accessibility-oriented learning medium that integrates text, audio narration, instructional videos, and interactive navigation within a single platform. Unlike conventional e-books that primarily provide text and images or multimedia applications that mainly deliver video-based content, AVooks combines multiple learning resources into an integrated and accessible environment specifically designed to support flipped classroom learning for students with physical disabilities. This design is expected to facilitate conceptual understanding while simultaneously enhancing learning independence and self-efficacy through more flexible, inclusive, and interactive learning experiences.

Various previous studies have examined flipped classrooms, digital learning media, self-efficacy, and learning independence separately (Hava, 2018; Ghaznavi et al., 2021; Syarief et al., 2022; Kuru, 2023; Daugherty & Topalcengiz, 2024; Mohammed & Bello, 2024; Sagita et al., 2025). However, there is still very limited research that integrates accessibility-based learning media with the flipped classroom model to increase the learning independence and self-efficacy of students with physical disabilities, especially in the Mathematics Learning Multimedia course. Therefore, the novelty of this study lies in the development of AVooks based on the flipped classroom model as an accessible, interactive, and adaptive learning medium aimed at improving both learning independence and self-efficacy among students with physical disabilities. Based on this background, this study aims to develop and evaluate the effectiveness of AVooks (Audio-Visual Books) based on the flipped classroom model in enhancing the learning independence and self-efficacy of university students with physical disabilities enrolled in the Multimedia Mathematics Learning course.

2. RESEARCH METHODOLOGY

This research uses a Research and Development (R&D) approach to develop and test the feasibility and effectiveness of flipped classroom-based AVooks (Audio-Visual Books) for improving learning independence and self-efficacy. The development model used in this study is the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model because it is systematic, flexible, and suitable for developing technology-based learning media (Kalonde et al., 2026).

Research Subjects

The subject of this study is a student of the undergraduate program with physical disabilities who is taking the Multimedia Mathematics Learning course in the Mathematics Education Study Program at a university in the city of Semarang, Indonesia. The selection of research subjects uses saturation sampling techniques because all populations are samples consisting of two samples. The participants consisted of students with physical disabilities characterized by upper- and lower-limb deformities. Although they experienced motor limitations, all participants were able to ambulate independently without using wheelchairs or other mobility aids and had no cognitive impairments that could interfere with the learning process. Their motor limitations primarily affected activities requiring fine motor coordination, such as operating computers, using multimedia software, and completing repetitive digital tasks during laboratory-based learning. However, in this study, it can also be used for all students in one class. Purposive sampling was selected because the objective of this Research and Development (R&D) study was not to generalize the findings to all students with disabilities but to evaluate the feasibility and effectiveness of AVooks for a specific group of learners with physical disabilities who experience motor-function limitations in computer laboratory activities. Therefore, participants were intentionally selected to ensure that the developed product was evaluated by its intended users within an authentic, inclusive learning context.

Needs Analysis

The initial stage carried out in this study is needs analysis. The needs analysis stage aims to identify learning problems, characteristics of students with physical disabilities, and the need for learning media to be developed. Data were collected through observation, semi-structured interviews with students and lecturers in the Multimedia of Mathematics Learning course, as well as literature studies on inclusive learning, digital learning media, and flipped classroom models. The data from the interview results were analyzed using thematic analysis which included four stages, namely data reduction, open coding, grouping codes into categories, and determining the main theme. The analysis was carried out to identify problem patterns and user needs for accessible learning media. From the results of the analysis, four main themes were obtained, namely: (1) student obstacles in operating computers and multimedia software due to limited motor function; (2) the need for learning media that can be accessed flexibly according to the physical condition of students; (3) the need for material presentation that integrates text, audio, video, and step-by-step demonstrations; and (4) the need for learning that allows students to learn the material independently before participating in practicum activities in the laboratory.

The findings at the needs analysis stage are the basis for the preparation of the AVooks design. The results were used to determine the structure of the material, the preparation of storyboards, the development of accessibility features, the selection of multimedia components, interactive navigation, and the design of flipped classroom-based learning scenarios. Thus, AVooks is developed not only based on theoretical studies, but also based on the real needs of users so that it is expected to be able to support more inclusive, adaptive, and student-centered learning. The interview framework is arranged so that the content of the questions is in accordance with the purpose of the research (Ardiansyah et al., 2023). The following is the interview framework used in this study.

Table 1
Needs analysis interview grid

Learning Components	Indicator
Educators	Lecturers' contribution to learning. Submission of lecture plans for one semester.
Student	Student motivation in learning, especially in computer practice. Difficulties for students in lectures in general and computer practice in particular. The interest of students in lectures in general and computer practice in particular.
Purpose	Suitability of learning objectives with CPL, CPMK, and sub-CPMK. Presentation of learning objectives by lecturers. Achievement of learning objectives.
Method	The learning method used in the computer practice course. Learning methods required for students in computer practice courses.
Material	Suitability of the material to the learning objectives. The material presented can be understood and studied by students.
Learning Media	Assisted learning media have been used in computer practice. The suitability of learning media for the course material. Learning media needed by students in computer practice courses.
Evaluation	Compatibility of evaluation with CPMK and sub-CPMK. The assessment system that students want in computer practice courses.

Design Stage

The design stage aims to produce an initial design of AVooks (Audio-Visual Books) based on the results of user needs analysis and literature review on inclusive learning, multimedia learning, and flipped classroom models. At this stage, a learning design is prepared that integrates materials, media, learning activities, and evaluations into a single learning system that is accessible to students with physical disabilities. The structure of AVooks is designed in the form of an interactive digital book consisting of several main components, namely: (1) learning outcomes and instructions for use, (2) text-based learning materials that are systematically arranged, (3) audio narrations to help students understand the material without relying entirely on text, (4) video tutorials that show step-by-step demonstrations of creating multimedia learning mathematics, (5) interactive navigation that makes it easier for students to access each part of the material, (6) practicum and exercise sheets, and (7) formative quizzes as a means of evaluating student understanding. All of these components are designed in one platform so that students can access the material flexibly according to their needs and learning abilities.

AVooks is integrated with the Learning Management System (LMS) as a digital learning environment that supports access to all materials, learning activities, assignments, and evaluations. Through the LMS, students can learn the material independently, re-access video tutorials and audio narrations, do exercises, collect assignments, and interact with lecturers and other students. This integration provides flexibility in learning time and place so that it really supports the needs of students with physical disabilities who need longer learning time according to their motor conditions. The application of the flipped classroom model is designed by dividing the learning process into two stages. The first stage is asynchronous learning, where students learn material through AVooks on the LMS before attending face-to-face lectures. At this stage, students learn concepts, observe tutorial videos, listen to audio narrations, and try exercises independently. The second stage is synchronous learning, which involves activities in computer laboratories that focus on discussions, demonstrations, guided practices, problem solving, and feedback by lecturers. All AVooks designs are then poured into a storyboard that contains the order of presentation of the material, navigation structure, integration of multimedia components, learning activities, and flipped classroom implementation scenarios.

Development Stage

In the development stage, the AVooks design that had been prepared in the previous stage was implemented into an initial product using multimedia development software and integrated into the Learning Management System (LMS). The products developed include text-based materials, audio narration, video tutorials, interactive navigation, practicum sheets, and formative quizzes that support flipped classroom-based learning. Furthermore, the AVooks prototype was validated by material experts and media experts to assess aspects of the content, presentation, language, appear.

Implementation Stage

The implementation stage aims to test the use of AVooks in the real learning process in the Mathematics Learning Multimedia course. AVooks is implemented through a flipped classroom model that integrates asynchronous and synchronous learning based on the Learning Management System (LMS). In the asynchronous stage, students learn the material, listen to audio narration, observe video tutorials, and do exercises independently through the LMS before attending lectures. Furthermore, at the synchronous stage in the computer laboratory, lecturers facilitate discussions, demonstrations, guided practices, problem solving, and provide feedback based on the results of student independent learning. After the entire learning series is completed, learning independence and self-efficacy are measured through the provision of pretest and posttest questionnaires to evaluate the effectiveness of AVooks as an inclusive learning medium.

Data Analysis

Data analysis at the development stage is validation of learning and media experts, conducted using a validation sheet. Learning validation validates learning prototypes, and media validation validates AVooks media. The analysis of the validity data follows the following stages: converting qualitative assessment data into a quantitative score of 1–4, as defined by the assessment rubric. Calculate the average score of each indicator with the formula:

$$\bar{X} = \frac{\sum X}{N}$$

Information:
$\bar{X}$: average score
$\sum X$: total score
N : number of test subjects

Interpret qualitatively the average value of each aspect and all aspects using the criteria that can be seen in Table 2.

Table 2
Classification of Validity Assessment Aspects

Qualitative Data	Criterion	Average Score Range
1	Highly Valid	3.25 < ≤ 4.00$\bar{X}$
2	Valid	2.50 < $\bar{X}$ ≤ 3.25
3	Less Valid	1.75 < $\bar{X}$ ≤ 2.50
4	Invalid	1.0 < $\bar{X}$ ≤ 1.75

Source: (Kholifah and Ekayati, 2023)

At the implementation stage, data in this study was collected through several techniques, namely: (1) questionnaires, used to measure student learning independence and self-efficacy, (2) expert validation sheets, used to assess the feasibility of Avooks products, (3) observation, to see the implementation of flipped classroom learning, and (4) interviews, to explore students' responses and experiences to the use of AVooks. The instrument used in this study is a learning independence questionnaire developed based on indicators such as learning initiatives, responsibility, and self-management. The following is a grid of student learning independence questionnaires used in the research (Hasanah et al., 2022).

Table 3
Learning Independence Questionnaire Grid

No	Aspects	Indicator
1	Learning initiatives	Find additional learning resources
2	Responsibilities	Completing tasks on time
3	Learning discipline	Manage study time
4	Confidence in learning	Be confident in your own learning results
5	Perseverance	Not easy to give up
6	Self-control	Evaluate learning outcomes

The learning independence questionnaire instrument, based on Table 3, is valid and reliable. The validity test was carried out using the Pearson Product-Moment correlation on the 25 items of the learning independence questionnaire. Instrument trials were conducted on 30 respondents outside the research sample. Based on the analysis, the calculated r values ranged from 0.412 to 0.781, while the table r value at the 5% significance level with N = 30 was 0.361. Thus, all statement items have a value of r calculated > r in the table, so they are declared valid. However, 2 items with values close to the minimum threshold (r < 0.45) have been revised to improve editorial clarity. Thus, it can be concluded that learning to play independent instruments is suitable for research. The reliability test was conducted using Cronbach's alpha. The results of the analysis showed that Cronbach's alpha was 0.913, indicating a very high level of internal consistency. This shows that the instrument has excellent internal consistency, enabling it to measure learning independence reliably.

The self-efficacy questionnaire assesses self-confidence in completing academic tasks. The following is a self-efficacy questionnaire grid used in the research (Listiana et al., 2025).

Table 4
Self-Afficacy Questionnaire Grid

No	Aspects	Indicator
1	Difficulty level	Confidence in completing difficult tasks
2	Strength	Consistency of belief
3	Generality (cakupan)	Transfer of beliefs to other situations
4	Self-motivation	Internal push
5	Resilience	Resilience in the face of failure

The self-efficacy instrument is compiled from Table 4 and consists of 20 statements organized by the aspects of level, strength, and generality. The results of the validity test showed that the calculated r value ranged from 0.438 to 0.804, with a table r value of 0.361. All statements have a value of r calculated > r table, so they are declared valid and can be used in research. No items were eliminated, but some items were added to the editorial to enhance readability. The reliability test results showed a Cronbach's alpha of 0.897, which is in the high category. This shows that the self-efficacy instrument is highly consistent and can be used as a reliable measure.

Quantitative data analysis from learning independence and self-efficacy data obtained during 7 meetings of research subjects was carried out using longitudinal descriptive, namely by comparing the scores of the two subjects at each meeting. The rate of improvement was analyzed using the percentage of achievement against the maximum score and the Normalized Gain (N-Gain) value calculated from the initial score and the final score of the implementation for each subject, then averaged. The development of the two variables is presented in the form of tables and graphs to illustrate the pattern of change during the seven meetings. Furthermore, the results of observations and interviews were analyzed using thematic analysis to explain changes in learning behavior and strengthen the interpretation of quantitative findings. Here's how to calculate the percentage of achievement against the maximum score.

$$\text{Achievement Percentage (\%)} = \frac{Obtained\ Score}{Maximum\ Possible\ Score\ Average\ Score} \times 100\%$$

The value of the Normalized Gain (N-Gain) is calculated using the formula:

$$g = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Score - Pretest\ Score}$$

With the following Normalized Gain (N-Gain) categories (Aslamiyah, 2023).

Table 5
N-Gain Interpretation Criteria

N-Gain Value (g)	Category
$g \geq 0.70$	High
$0.30 \leq g < 0.70$	Moderate
$g < 0.30$	Low

3. RESULTS

The results of the research analysis were obtained through interviews with research subjects, namely, students with disabilities who are prospective mathematics teachers. The purpose of the interview was to identify the needs of students with disabilities in lectures conducted in computer laboratories. The following are the results of an interview with the research subject, namely, one student.

Table 6
Results of Wawancana Analysis of the Needs of Disabled Students

Learning Components	Indicator	Interview Results
Educators	Lecturers' contribution to learning.	There are teaching materials from lecturers that help you learn the function of each icon in the software. In addition, lecturers are expected to design a variety of learning activities to increase students' motivation to learn.
	Submission of lecture plans for one semester.	The RPS delivered by lecturers should not only be delivered at the beginning but also be reinforced with each achievement, so that we know the achievements in each lecture.
Student	Student motivation in learning, especially in computer practice.	Student motivation in attending lectures correlates with lecturers and the courses to be followed. Students are more motivated in computer practice than in pure mathematics courses.
	Difficulties for students in lectures in general and computer practice in particular.	The difficulty for students in computer practice is the time to complete the project at each meeting. During computer practice, students with disabilities are slow to follow the lecturers' directions.
	The interest of students in lectures in general and computer practice in particular.	Students like courses that apply technology, so that when they study in a computer laboratory, they are more motivated than in theoretical lectures in class. However, if theoretical courses use technology, they are also motivated to learn.
Purpose	Suitability of learning objectives with CPL, CPMK, and sub-CPMK.	Some courses have learning objectives known to students, but others are unclear to them.
	Presentation of learning objectives by lecturers.	There is compatibility between the material and the course's learning objectives.
	Achievement of learning objectives.	Students often forget the course's achievements because the lecturer only informs them of the overall course achievements at the beginning of the meeting.
Method	The learning method used in the computer practice course.	During the practical lecture in the computer laboratory, the lecturer used only direct practice, and then students were asked to develop a project based on the practical material presented.
	Learning methods required for students in computer practice courses.	The method desired by students in lectures is a project, but with clarity in each stage. Students want feedback on the results of completed assignments.
Material	Suitability of the material to the learning objectives. The material presented can be understood and studied by students.	The material delivered by the lecturer aligns with the course and learning objectives. Regarding the material, there needs to be greater clarity from the coding provided on the usability and usefulness of applications in computer practice courses.
Learning Media	Assisted learning media have been used in computer practice.	The learning media are limited to PPT, and several lecturers use videos in theory courses. However, in the practicum course, no one has used video material.
	The suitability of learning media for the course material.	The media provided were PPT and textbook materials. The content of the media used is in accordance with the course.
	Learning media needed by students in computer practice courses.	Students want audio-visual learning media for practical courses in computer laboratories. These media can be made available to students in advance of lectures so that they can practice at home first and, if they have difficulties, ask the lecturer when studying in the computer laboratory.
Evaluation	Compatibility of evaluation with CPMK and sub-CPMK.	Students want feedback on the results of completed assignments.
	The assessment system that students want in computer practice courses.	Evaluations are given at the middle and end of the semester.

Table 6 shows that the results of in-depth interviews with students revealed that the difficulties and obstacles of students with disabilities in attending lectures include: (1)

difficulties in practicum courses in computer laboratories, as lectures are carried out in computer laboratories, mathematics teaching aids laboratories, learning video laboratories, and microteaching laboratories, so students have difficulties in operating computers. The direct practice system makes it difficult for students with disabilities to follow lecturers' directions during practicum due to physical limitations in their hands, so they often miss practice materials. In addition, the student needs to record important points regarding the practical material, which will certainly make it more difficult for the student to concentrate on receiving the material and direct practice. (2) Student motivation in practicum courses in computer laboratories is higher than in theory courses in class, because students like learning using technology. However, during theory lectures in technology-enabled classes, students are also motivated. (3) Students want audio-visual learning media for practical courses in the computer laboratory, and the media can be made available to students in advance before lectures, so that students can practice first at home, so that if they have difficulties, they can ask the lecturer when studying in the computer laboratory. (4) Students want feedback on the results of the assignments that have been done.

Based on the results of the needs analysis for students with disabilities in the mathematics animation multimedia course, whose learning objectives aim to develop students' skills in producing multimedia animations for mathematics learning at school, it is necessary to design a more efficient learning environment that enables students to learn anywhere, anytime. Learning innovations that can be used are Flipped Classroom learning assisted by AVooks media and Flipped Classroom Learning Innovations Assisted by AVooks (Audio Visual Books) for Visually Impaired Students in the Mathematics Animation Multimedia Course, including: Learning with the Flipped Classroom method using LMS ifmiph.unimus.ac. which contains lecture materials packaged in AVooks (Audio Visual Books). AVooks is a book containing tutorial videos on creating mathematical multimedia animations using PPT, iSpring, web APK, and Articulate Storyline 3. The videos are 5-10 minutes long, so in a single meeting, you can cover 2-3 video tutorials. The video not only contains visuals but also audio that explains each stage of creating multimedia for mechanized animation. In addition, the LMS includes projects that students must complete, as well as assessments conducted both offline and online. Students are asked to study the material in the LMS and complete the projects before the offline meeting in the laboratory, with the project collection limit set for offline meetings. With such a learning system, students with disabilities can learn and practice directly before offline hours take place. Not only students with disabilities, but also non-disabled students can learn first in the Constitutional Court multimedia animation mathematics.

Fig 1. Avooks-Assisted Flipped Classroom Learning Design

The learning design in Figure 1 shows that learning occurs outside the classroom, first through an LMS that contains AVooks materials for students to learn and complete existing activities as assignments or projects. During lectures, lecturers and students discuss obstacles or problems encountered during activities previously carried out in the LMS. The LMS includes materials and activities for each meeting so students can learn them in advance. Here is the LMS design in Avooks-Assisted Flipped Classroom learning.

Table 7
Avooks-Assisted Flipped Classroom Learning Design On LMS

Activities	Avooks-Assisted Flipped Classroom Design on LMS
Introduction to Lectures	 **Fig 2. Introductory Design of Mathematics Animation Multimedia Course** Figure 2, the introduction to the Multimedia Mathematics Animation course, contains: course flyers, course opening greetings, course identity, course learning outcomes, and instructions for using the LMS.
Opening Activities	 **Fig 3. Lecture Opening Activity**

Figure 3 shows that the opening activity of the lecture contains greetings, similar to when the lecturer opens the lecture in class, namely saying the wrong thing and asking for news from the students. However, the opening activity not only contains greetings but also provides general information, materials, and lecture objectives to be studied at that time. In the opening activity on the LMS, additional information was also presented, including concept maps, motivational videos, and material posters. However, each general information meeting provided is of a different type. The following is the design of the general information in the opening activity.

Fig 4. Concept Map of Mathematics Animation Multimedia Course

Fig 5. Differentiated Learning Motivation Video

Fig 6. Infographic Poster Student Needs Analysis Material

Core Activities

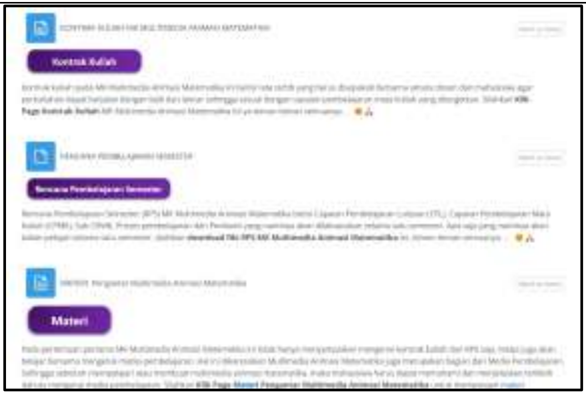

Fig 7. Core Activities Contain Material

Figure 7 shows the core activities in the LMS that contain the material. The material presented begins with general information before entering the core material. This general information aims to motivate students to be curious about Multimedia Animation Mathematics. The core information in the material is presented as PowerPoint presentations, most of which are learning videos. The PowerPoint media provided can be viewed by students, and they can run them interactively directly in the LMS. So students not only download the material but also actively listen to it. The PowerPoint material uses the activities available on the LMS, namely the HTML page. The following is a learning medium in the form of an interactive PowerPoint.

Fig 8. Interactive PowerPoint Media

Lecture material is not only in PowerPoint format but also in audiovisual format, namely AVooks. The naming of Avook comes from Audio Visual Books. The Books in question are in the LMS and contain audio-visual media, which amount to several meetings and activities on audio-visual media that students can study, so there are several activity pages; they are called Books. The following is the audiovisual media on the LMS.

Fig 9a. The Audiovisual Media on The LMS

Fig 9b. The Audiovisual Media on The LMS

Fig 9c. The Audiovisual Media on The LMS

Student Assignments or Projects

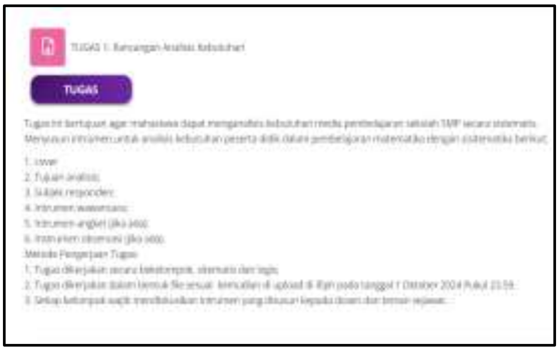

Fig 10. Task Layout in LMS

Figure 10 shows that the LMS for the Multimedia Mathematics Animation course also contains assignments that students must complete. The assignment design is carried out in groups, with assignment submission settings also set to groups, meaning that users of the mathematics animation multimedia course are grouped first by creating Groups. So that the collection of tasks is sufficient for one member, and other members automatically send assignments. This will also apply during grading: if one member of the group is graded, the other members will automatically receive the same score. The following is the user group setting that has been done.

Fig 11. Grouping of Users of Mathematics Animation Multimedia Courses.

In LMS, group project activities can also be given. The project certainly needs a preparatory stage, so that the final results of the Multimedia Mathematics Animation course are designed in stages within the LMS. The following group projects are given on the LMS.

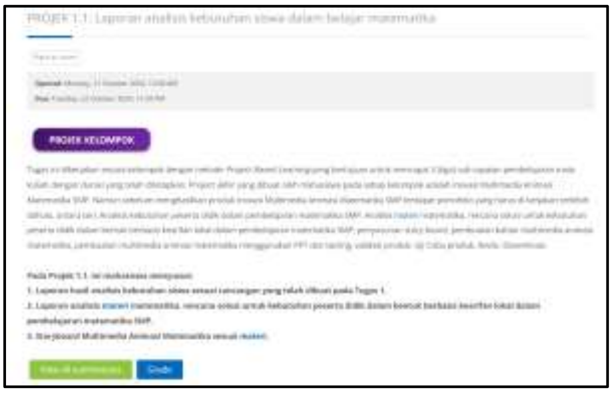

Fig 12. Group Projects

Figure 12 shows that the group project includes not only a required project file but also a project description and a project order that students must complete within the set time constraints. If students have submitted assignments, the lecturer will provide an assessment in the LMS and provide feedback through the comment column. The following is the feedback given by the lecturer.

Fig 13. Student Assignment Feedback

The Flipped Classroom learning above also uses AVooks learning media, namely audio-visual media, multimedia course materials, and mechanical animation. AVooks contains a lot of audiovisual media, including theoretical videos and practice videos or tutorials on creating multimedia mathematical animations. The following is the AVooks media design for Flipped Classroom learning for students with disabilities.

Table 8
Avooks Media Design on Flipped Classroom Learning

<table>
<tr><th>Other Media AVooks</th><th>AVooks Media Design</th></tr>
<tr><td>Intro</td><td>
The AVooks intro design begins with the Ministry of Education and Culture logo, followed by the Unimus logo, which is a beautiful sound for the intro. All AVooks media are given the same intro. Here is the layout of the AVooks intro.

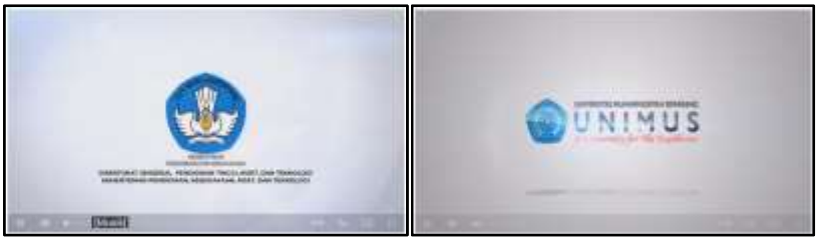

Fig 14. AVooks Media Intro: Ministry of Education and Culture Logo and Unimus Logo

In the next intro design, the title of the material to be studied on AVooks appears, accompanied by intro music different from the previous one. The layout of the material title varies across AVooks, but it still conveys the title. The following is the intro to the material's title on AVooks.

Fig 15. Intro to the Title of the Material on AVooks Media
</td></tr>
<tr><td>Prologue</td><td>
The prologue on AVooks is designed by first giving a sample to the audience, followed by a self-introduction from the talent. After that, the talent will convey general information about the material from each AVooks. However, some AVooks media do not feature talent but still convey AVooks' material. The following is the layout of the prologue on AVooks.

Fig 16. AVooks Prologue Using Talent

In the prologue of AVooks that do not use talent, the AVooks usually continue the previous activity, meaning that AVooks media that do not use talent are Activity 2, Activity 3, and so on. However, AVooks media in Activity 1 of the prologue session features talents who provide general information about the AVooks material. Even so, the prologue that does not use talent still has an audio that outlines the AVooks material. Here is the prologue of AVooks that does not use talent.

Fig 17. AVooks Prologue Does not Use Talent
</td></tr>
</table>

Content of the material	The content of the material on AVooks is certainly aligned with the previously prepared Semester Learning Plan. Delivering material on AVooks with the help of the Canva application. The content can take the form of theories and tutorials on creating multimedia mathematical animations using Canva, PowerPoint, and Articulate Storyline 3. The following is the layout of AVooks' content.

Fig 18. AVooks Material in the Form of Theory

Fig 19. AVooks Materials in the Form of Tutorials

Cover	Covers on AVooks media are of two types. The first closing uses talent to deliver the closing to the media, and the second does not use talent but still includes audio conveying the closing to the media. The following is the cover layout for AVooks media.

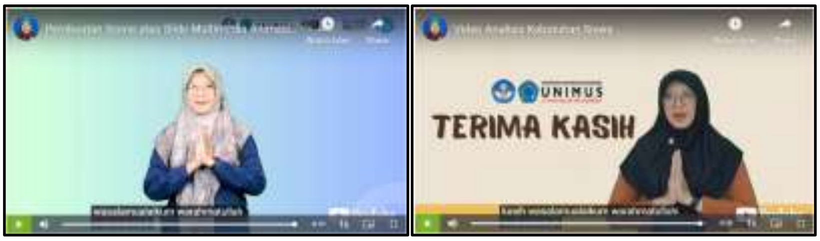

Fig 20. AVooks Cover Using Talent

Based on the flipped classroom learning design and AVooks media design on the LMS above, validation is carried out by experts. 3 learning experts carried out the validation of Flipped classroom learning on LMS. Media validation carried out by media validators is reviewed from several aspects: learning activity, LMS interface, assessment, and learning media. The flipped classroom learning validation instrument used is an expert validation sheet consisting of 13 questions, with assessment criteria rated on a 1–4 scale. The following are the results of the learning assessment by experts.

Table 9

Results of Flipped Classroom Learning Validation on LMS

No	Aspects	Validator			Average	Criterion
		1	2	3		
1	Learning activities	3	3,5	4	3,5	Highly Valid
2	Interface LMS	3,5	3	4	3,5	Highly Valid
3	Valuation	3,6	3	3,8	3.46	Highly Valid
4	Content Learning media	3,25	3	4	3,41	Highly Valid
				Final Score	3,47	Highly Valid

Table 9 shows the results of the validation of the flipped classroom learning design integrated in the Learning Management System (LMS) based on the assessment of three validators. Overall, the learning design obtained an average score of 3.47, so it was included in the very valid category. These results show that the learning design has met the feasibility aspects in terms of learning activities, LMS interface, assessment system, and learning media content, so that it is feasible to implement it at the trial stage.

Based on the validation results, the learning activity and LMS interface aspects obtained the highest average score, which was 3.50. This shows that the flipped classroom syntax, which integrates asynchronous learning through LMS and synchronous learning in the laboratory, is considered to be in accordance with the characteristics of students and supported by an easy-to-access and user-friendly LMS display. On the other hand, the content aspect of learning media obtained the lowest average score, which was 3.41, although it was still in the very valid category. The validator provided input so that some materials were compiled more systematically, instructions for using AVooks were clarified, and examples of multimedia use of mathematics learning were multiplied to make it easier for students with physical disabilities to understand. In addition, in the assessment aspect (average of 3.46), the validator suggested that the practice assessment indicators be presented in more detail so that students better understand the success criteria for each assignment given.

The next validation is for Avooks media. 3 media experts carried out Avooks media validation. Media validation carried out by media validators is reviewed from four aspects: audio, convenience, display, and media information. The AVooks media validation instrument employs a media expert validation sheet comprising 14 questions and assessment criteria rated on a scale of 1–4. The following are the results of the media experts' assessment.

Table 10
Results of AVooks Learning Media Validation

No	Aspects	Validator			Average	Criterion
		1	2	3		
1	Audio	3,6	4	3,66	3,7	Highly Valid
2	Convenience	3,5	4	4	3,6	Highly Valid
3	Display	3,6	3,2	3,4	3.4	Highly Valid
4	Information about the media	3,33	3,66	3,6	3,5	Highly Valid
				Final Score	3,6	Highly Valid

Table 10 shows the results of the validation of AVooks learning media based on the assessment of three validators. Overall, AVooks media obtained an average score of 3.60 with a very valid category, so it was declared suitable for use as a learning media at the implementation stage. These results show that AVooks has met the media quality aspects which include audio, ease of use, display, and presentation of media information.

Based on the validation results, the audio aspect obtained the highest average score, which was 3.70, which indicates that the quality of the narrative, sound clarity, and synchronization between the audio and the learning material have been rated very good. The ease of use aspect also received a high score of 3.60, which indicates that the navigation, menu structure, and access to AVooks features are easy to understand and can be used independently by students with physical disabilities. In contrast, the display aspect obtained the lowest average score of 3.40, although it was still in the very valid category. Validators provide feedback to improve layout consistency, font size selection, color combinations, and navigation icon placement so that media displays are more convenient and accessible. In addition, in the aspect of information about media (average 3.50), validators suggested that instructions for using AVooks and information about the functions of each feature be presented in more detail to make it easier for students to operate media independently.

The next stage is the implementation of Avooks, a flipped classroom approach, within the

LMS in animated multimedia courses for students with disabilities. The following are the results of learning independence from two subjects during 7 meetings.

Table 11
Average Recapitulation and Percentage of Learning Independence Achievement

Meetings	S1	S2	Average	Percentage Achievement
1	2,33	2,17	2,25	45,00%
2	2,83	2,50	2,67	53,40%
3	3,33	3,00	3,17	63,40%
4	4,00	3,50	3,75	75,00%
5	4,17	4,00	4,08	81,60%
6	4,33	4,17	4,25	85,00%
7	4,83	4,33	4,58	91,60%

Table 11 shows that the average learning independence of the two subjects increased from 2.25 at the first meeting to 4.58 at the seventh meeting. The calculation using Normalized Gain (N-Gain) yields a value of 0.85, which falls into the high category. Overall, the achievement percentage increased by 46.60 percentage points, from 45.00% at the beginning of implementation to 91.60% at the end of implementation. These results show that the use of AVooks is able to increase the learning independence of students with physical disabilities gradually until it reaches a very high achievement category. These findings indicate that the integration of AVooks with the flipped classroom model provides students with the opportunity to learn according to their speed and needs, so that they are better able to manage the learning process. Further analysis of self-efficacy.

Table 12
Average Recapitulation and Percentage of Self-efficacy

Meetings	S1	S2	Average	Percentage Achievement
1	2,17	2,00	2,08	41,60%
2	2,83	2,33	2,58	51,60%
3	3,17	3,00	3,08	61,60%
4	4,00	3,33	3,67	73,40%
5	4,00	4,00	4,00	80,00%
6	4,33	4,17	4,25	85,00%
7	4,83	4,50	4,67	93,40%

Based on table 12, the results of the Normalized Gain (N-Gain) calculation show a value of 0.89, which is included in the high category. These findings show that the implementation of flipped classroom-based AVooks provides a high increase in the self-efficacy of students with physical disabilities. This increase indicates that students are more confident in their ability to understand material, operate multimedia software, and complete academic tasks independently during the learning process. Meanwhile, the percentage of self-efficacy achievement also increased by 51.80 percentage points, which indicates that the use of AVooks not only supports material mastery, but also strengthens the confidence of students with physical disabilities in carrying out academic activities. These findings show that the integration of AVooks with the flipped classroom model is able to create a more adaptive learning experience, provide learning opportunities at the pace of each student, and provide mastery experiences that gradually increase self-efficacy.

4. DISCUSSION

The findings indicate that AVooks (Audio-Visual Books), integrated with the flipped classroom model, effectively supports inclusive learning for university students with physical disabilities in the Multimedia Mathematics Learning course. The participants in this study were students with physical disabilities characterized by upper- and lower-limb deformities who were able to walk independently without using wheelchairs or other mobility aids. Although they had no cognitive impairments, their motor limitations made operating computers, using multimedia software, and completing repetitive digital tasks more challenging. In this context, AVooks functions not only as a digital learning resource but also as an accessible and adaptive learning medium that allows students to learn according to their individual abilities and learning pace. These findings suggest that the effectiveness of inclusive learning depends on the alignment between learning media, students' accessibility needs, and appropriate instructional strategies (Burgstahler, 2021; Mohammed & Bello, 2024).

The improvement in learning independence can be explained through Zimmerman's Self-Regulated Learning theory, which emphasizes learners' ability to plan, monitor, and evaluate their own learning processes (Zimmerman, 2002; Panadero, 2017). AVooks supports these processes through audio narration, visual tutorials, LMS-based accessibility, and opportunities to revisit learning materials repeatedly before classroom sessions. These features encourage students to prepare independently, identify learning difficulties, and regulate their own learning strategies. Likewise, the improvement in self-efficacy is consistent with Bandura's Self-Efficacy theory, in which mastery experiences, vicarious experiences, and verbal persuasion are key sources of confidence development (Bandura, 1997). The combination of repeated practice through AVooks and interactive discussions with lecturers and peers enables students to gain successful learning experiences that strengthen their confidence in completing academic tasks.

The positive outcomes observed in this study should be interpreted as the combined contribution of AVooks, the flipped classroom model, and the Learning Management System (LMS), rather than the effect of a single component. During the asynchronous phase, students studied concepts and practiced multimedia skills independently using AVooks before attending laboratory sessions. The synchronous phase was then used for guided practice, discussion, clarification, and feedback. This learning sequence reduced cognitive overload during classroom activities and enabled students to use face-to-face sessions more effectively. These findings support previous studies reporting that flipped classrooms enhance learning readiness, engagement, and active participation by allowing students to acquire foundational knowledge before classroom instruction (Bishop & Verleger, 2013; Aidoo et al., 2022; Alan & Yurt, 2024).

The novelty of this study lies in the development of AVooks as an accessibility-oriented audio-visual learning medium specifically designed for university students with physical disabilities in Multimedia Mathematics Learning. Unlike conventional e-books that primarily present text and images, multimedia modules that target general learners, or video-based learning that mainly delivers instructional content, AVooks integrates text, audio narration, visual tutorials, interactive navigation, and accessibility features within a single platform that supports flipped classroom implementation. This integrated design extends previous studies by demonstrating that accessible digital learning media can simultaneously enhance learning independence and self-efficacy among students with physical disabilities while supporting inclusive higher education (Lazzari, 2023; Mohammed & Bello, 2024).

This study has several limitations. First, it employed a one-group pretest-posttest design without a control group, limiting causal conclusions regarding the effectiveness of the intervention. Second, the number of participants was relatively small and limited to students with upper- and lower-limb deformities who were able to ambulate independently without wheelchairs. Third, the study was conducted in a single study program and course, which may limit the generalizability of the findings. Future studies are recommended to adopt quasi-

Tsaqila Jurnal Pendidikan dan Teknologi [TJPT]
Vol 6 Nomor 1 July 2026, hal: 148-171
ISSN: 2807-6273

experimental or experimental designs with control groups, involve more diverse disability characteristics, and examine the relative contributions of AVooks, the flipped classroom model, and the LMS to students' learning independence and self-efficacy (Creswell & Creswell, 2023).

A flipped classroom approach, supported by AVooks (Audio Visual Books), was designed to address problems experienced by students with disabilities in practicum courses in computer laboratories. The average learning validation result was 3.47. The results show that flipped classroom learning in an LMS is suitable for use in mathematics animation courses. The flipped classroom is a learning process using 2 learning methods, namely asynchronous and synchronous learning (Aidoo et al., 2022). Asynchronous learning is a teaching and learning model that involves students learning separately, meaning that they do not study in the same place and not at the same time (Dio, 2022). Lecture materials are presented on the university's Learning Management System (LMS), which includes preliminary, core, and closing activities. The introductory activity includes greetings to students, followed by an introduction to the lecture activities. Core activities contain activities that must be learned and practiced by students. The activities contain learning media in the form of: 1) individual audio media (learning videos) with a duration of 5 – 10 minutes, consisting of at least 2 videos at each meeting. 2) Presentation media that can be directly operated by students interactively on the LMS without the need to download. 3) E-module media that students can learn from. These media contain theoretical or tutorial material for creating multimedia mathematical animations.

Using the asynchronous method can make it easier for students with disabilities to learn material before class (Knotts & Seago, 2022). So that during classroom learning, namely synchronous learning, students discuss with lecturers and peers about difficulties so that they can improve suggestions in the practice of multimedia mathematical animation. The flipped classroom approach integrates asynchronous and synchronous learning to support students who have difficulty learning in the classroom. (Osman, 2022; Area & Yurt, 2024). This is because of the flipped classroom approach: students can learn the material asynchronously first, and then it is reinforced synchronously to help them master the knowledge they must learn (Lazzari, 2023; Susiyawati et al., 2024). Students with disabilities who have difficulty operating computers or laptops can first learn material and practice through asynchronous learning media, then continue discussions with lecturers and peers during synchronous laboratory practice. Flipped classroom learning is carried out using AVooks media, namely Audio Visual Books.

The results of implementing AVooks (Audio-Visual Books) in a flipped classroom show that AVooks significantly increase students with disabilities' learning independence and self-efficacy. The increase is evident from the result of the percentage of achievement and the result of N gain. This indicates that the interventions provided are not only statistically effective but also have a substantive impact on the student learning process. The flipped classroom model encourages students to learn independently before lectures, making them more engaged and prepared for classroom activities.

The increase in learning independence in this study is in line with the self-regulated learning theory put forward by Zimmerman, where students are trained to plan, monitor, and evaluate their learning process (Aviory et al., 2025). AVooks, as a learning medium, provides access flexibility that allows students with disabilities to learn according to their physical conditions and rhythms. On the other hand, the increase in self-efficacy can be explained through Bandura's theory, where the experience of success in understanding the material through AVooks, as well as interaction in class discussions, is an important factor in building student confidence (Tamrin et al., 2025).

The novelty of this research lies in the development of flipped classroom-based AVooks, specifically designed for students with disabilities in multimedia mathematics learning. In contrast to previous research, which generally uses video media or conventional e-learning (Hardini, 2023; Oktaviani, 2025) AVooks integrates text, audio, and visual elements into a single adaptive and accessible platform. In addition, this research is unique in simultaneously examining two important variables, namely learning independence and self-efficacy, in the context of inclusive learning, which is still rarely researched. Overall, the findings of this study show that the combination of innovative learning media and the right pedagogical model can create an inclusive, flexible, and empowering learning environment for students with disabilities. The implication of this research is the importance of developing learning media that are not only technology-based but also consider students' accessibility needs and special needs. Thus, AVooks based on flipped classrooms can be an alternative for improving learning quality, especially by supporting students' independence and self-efficacy in inclusive higher education.

5. CONCLUSION

This study aimed to develop and evaluate the effectiveness of AVooks (Audio-Visual Books) based on the flipped classroom model in enhancing the learning independence and self-efficacy of university students with physical disabilities in the Multimedia Mathematics Learning course. The participants were students with physical disabilities characterized by upper- and lower-limb deformities who were able to walk independently without using wheelchairs or other mobility aids and had no cognitive impairments. The findings indicate that AVooks provides an inclusive, accessible, and adaptive learning environment that enables students to learn independently according to their individual abilities and learning pace. By integrating text, audio narration, instructional videos, and interactive navigation within a flipped classroom framework, AVooks not only facilitates conceptual understanding but also strengthens students' learning independence and confidence in completing academic tasks.

The novelty of this study lies in the development of AVooks as an accessibility-oriented audio-visual learning medium specifically designed for university students with physical disabilities characterized by upper- and lower-limb deformities. Unlike conventional e-books and general multimedia learning applications that primarily emphasize content delivery, AVooks integrates accessibility principles, interactive multimedia, and the pedagogical advantages of the flipped classroom model into a single learning platform. Theoretically, this study contributes to the advancement of inclusive learning in higher education by demonstrating that accessible and adaptive digital learning media can enhance the effectiveness of flipped classroom implementation in promoting learning independence and self-efficacy among students with physical disabilities.

From a practical perspective, the findings suggest that learning media in inclusive higher education should be designed not only to deliver instructional content but also to address the specific characteristics and accessibility needs of students with disabilities. Such an approach can empower students to participate more actively, learn more independently, and develop greater confidence throughout the learning process. Although this study focused on students with physical disabilities characterized by upper- and lower-limb deformities who were able to ambulate independently without wheelchairs, the AVooks development framework may serve as a reference for designing inclusive digital learning media for students with similar physical disability characteristics. Future studies are recommended to involve participants with more diverse disability profiles and to investigate the long-term impact of AVooks on academic achievement, learning engagement, and inclusive learning experiences.

ACKNOWLEDGMENT

Thank you to Lembaga Penelitian dan Pengabdian Masyarakat Universitas Muhammadiyah Semarang for the funding of the UNIMUS Internal Grant in accordance with Agreement Letter number 0155/UNIMUS.L/PG/PDP/PJ.INT/2024. Thank you also to the UNIMUS Mathematics Education S1 Study Program for supporting the implementation of the research.

REFERENCES

Aidoo, B., Tsyawo, J., Quansah, F., & Kwadwo Boateng, S. (2022). Students' learning experiences in a flipped classroom: A case study in Ghana. *International Journal of Education and Development Using Information and Communication Technology (IJEDICT)*, *18*(1), 67–85.

Alan, S., & Yurt, E. (2024). Flipped Learning: An Innovative Model for Enhancing Education Through ChatGPT. *International Journal of Modern Education Studies*, *8*(1), 124–148.

Amer, M. B. (2022). Student Teachers ' Perceptions of their Development of Century Competencies To cite this article : Student Teachers ' Perceptions of their Development of 21 st Century Competencies. *International Journal of Research in Education and Science*, *8*(4), 713–727. https://doi.org/10.46328/ijres.2948

Ardiansyah, Risnita, & Jailani, M. S. (2023). Teknik Pengumpulan Data Dan Instrumen Penelitian Ilmiah Pendidikan Pada Pendekatan Kualitatif dan Kuantitatif. *Jurnal IHSAN : Jurnal Pendidikan Islam*, *1*(2), 1–9. https://doi.org/10.61104/ihsan.v1i2.57

Aslamiyah, S. (2023). *Pengembangan Media Pembelajaran Information Communication And Technology berbasis STEM untuk Meningkatkan Kemampuan Literasi Matematis Siswa Materi Pola Bilangan Kelas VIII*.

Astuti, D. A., Kurniati, N., Syagata, A. S., & Sulisworo, D. (2024). Flipped Classroom Learning Pada Mahasiswa Kesehatan Sebagai Alternatif Pembelajaran Pada Masa Pandemi Covid-19. *Jurnal Ilmiah Kesehatan*, *13*(1), 12–19.

Aviory, K., Retnawati, H., & Sudiyatno, S. (2025). Factors affecting mathematics achievement : Online learning , self-efficacy , and self-regulated learning. *Journal of Pedagogical Research*, *9*(3), 276–290. https://doi.org/10.33902/JPR.202534085 Research

Ayub, D., Jaya, M., Putra, A., & Suryana, D. (2025). The instructional leadership and 21st-century competencies of Indonesian school principals. *Journal of Education and E-Learning Research*, *12*(2), 289–297. https://doi.org/10.20448/jeelr.v12i2.6892

Dio, R. V. (2022). Utilization of Digital Module for Asynchronous Online Independent Learning in Advanced Mathematics Education. *Mathematics Teaching-Research Journal*, *14*(1), 80–98.

Gani, R. H. A., & Wijaya, H. (2023). Pembelajaran berbasis masalah pada mata kuliah keterampilan berbicara pada mahasiswa disibilitas tuna daksa. *ALINEA: Jurnal Bahasa, Sastra Dan Pengajarannya*, *3*(1), 263–271.

Ghaznavi, N., Haddad Narafshan, M., & Tajadini, M. (2021). The Implementation of a Multiple Intelligences Teaching Approach: Classroom engagement and physically disabled learners. *Cogent Psychology*, *8*(1). https://doi.org/10.1080/23311908.2021.1880258

Harahap, R. M., Santosa, I., Wahjudi, D., & Martokusumo, W. (2019). Kajian Penerapan Desain Universal Pada Ruang Kuliah Bagi Disabilitas Pendengaran Di Perguruan Tinggi (Studi kasus : Ruang Kuliah Gedung CADL di ITB). *Narada : Jurnal Desain Dan Seni*, *6*(1), 1. https://doi.org/10.22441/narada.2019.v6.i1.001

Hardini, S. (2023). Pemanfaatan Video sebagai Media Tutorial dalam Pembelajaran Fiqih di MTs Muhammadiyah 25 Marubun Jaya. *Tsaqila Jurnal Pendidikan Dan Teknologi*, *3*, 37–48.

Hasanah, E., Desstya, A., Kusumawati, I., Limba, A., & Kusdianto, K. (2022). The Mediating Role of Student Independence on Graduate Quality in Distributed Learning. *International Journal of Instruction*, *15*(1), 61–82. https://doi.org/10.29333/iji.2022.1524a

Hava, K. (2018). The Impact of Digital Citizenship Instruction through Flipped Classroom Model on

Various Variables. *Contemporary Educational Technology*, *9*(4), 390–404. https://doi.org/https://doi.org/10.30935/cet.471013

Kalonde, G., Boateng, S., & Duedu, C. (2026). Integrative Analysis of ADDIE , ARCS , and ASSURE : Toward a Hybrid Framework for Technology-Enhanced Instructional Design. *Journal of Education and Learning*, *15*(2), 11–21. https://doi.org/10.5539/jel.v15n2p11

Khotijah, S., Juliana, J., & Driyani, D. (2023). Perancangan Media Pembelajaran Interaktif Bahasa Isyarat Bisindo Untuk Penyandang Disabilitas Tuna Rungu Berbasis Android. *Jurnal Ilmiah Multidisiplin*, *2*(1), 142–149. https://doi.org/10.59000/jim.v2i1.101

Knotts, A., & Seago, N. (2022). *Video in the Middle: Flexible Digital Experiences for Mathematics Teacher Education*. *Vim*, 2014–2023.

Kurnia, B. (2018). Pengembangan Car Asisstant For Physical Disability (Cantic) untuk Membantu Mahasiswa Disabilitas Fisik Bekendara di Lingkungan Rumah dan Perguruan Tinggi. *Jurnal UNIK Pendidikan Luar Biasa*, *8*(15).

Kuru, O. (2023). Classroom Teachers ' Perception Levels On Flipped Learning. *International Journal of Education & Literacy Studies*, *11*(4), 372–379. https://doi.org/http://dx.doi.org/10.7575/aiac.ijels.v.11n.4p.372

Lazzari, E. (2023). Flipped learning and affect in mathematics: Results of an initial narrative analysis. *European Journal of Science and Mathematics Education*, *11*(1), 77–88. https://doi.org/10.30935/scimath/12435

Listiana, L., Jamaluddin, A. Bin, Bahri, A., & Romadhon, N. H. (2025). The influence of self-efficacy , learning attitude , and learning independence on students ' metacognitive awareness and skills. *Journal of Pedagogical Research*, *9*(4), 19–34. https://doi.org/doi.org/10.33902/JPR.202534836 Research

Mohammed, I. A., & Bello, A. (2024). Performance of mathematics students using video learning in flipped and flipped collaborative learning settings. *Pedagogical Research*, *9*(3), em0213. https://doi.org/10.29333/pr/14699

Odabaş, C., & Kahramanoğlu, R. (2023). Qualitative Analysis of the Relationship between Online Homework and Prior Success , Self-efficacy , Perceived Responsibility , Motivation and Academic Success. *International Journal of Modern Education Studies*, *7*(2).

Oktaviani, I. T. (2025). Transformasi Teknologi Pendidikan : Pengembangan Multimedia Interaktif Berbasis Aplikasi Android " NusaEdu " Untuk Siswa Kelas 7 SMP Melalui Implementasi Multimedia Development Life Cycle. *Tsaqila Jurnal Pendidikan Dan Teknologi*, *5*(2), 75–83.

Osman, S. Z. M. (2022). Combining Synchronous and Asynchronous Learning: Student Satisfaction with Online Learning using Learning Management Systems. *Journal of Education and E-Learning Research*, *9*(3), 147–154. https://doi.org/10.20448/jeelr.v9i3.4103

Pikk, K., Leijen, Ä., Radišić, J., & Uibu, K. (2025). Exploring the relationship between teachers ' beliefs on the nature and learning of mathematics and self-efficacy in teaching mathematics at the primary school level. *Lumat: International Journal on Math, Science, and Technology Education*, *13*(5), 1–23. https://doi.org/doi.org/10.31129/LUMAT.13.1.2504

Puspitosari, W. A., Faudyan, & Arni Surwati, I. (2022). Tantangan Mewujudkan Kampus Inklusi di Pendidikan Tinggi dalam Telaah Literatur. *Jurnal Moral Kemasyarakatan*, *7*(1), 55–67.

Sagita, L., Ilma, R., Putri, I., Charitas, R., & Prahmana, I. (2025). Bridging Mathematics and Financial Literacy Through Flipped Classroom. *Mathematics Teaching Research Journal*, *17*(5), 128–155.

Satyani, I. S. C., Agung, A., & Cahyadi, J. (2018). Perancangan Media Pembelajaran Animasi Bahasa Isyarat untuk Anak Disabilitas Tuna Rungu Usia 5-8 Tahun. *Jurnal DKV Adiwarna*, 1–10.

Susiyawati, E., Erman, E., Astriani, D., & Rahayu, D. A. (2024). Facilitating flexible learning: A study of students' perceptions of synchronous and asynchronous blended learning. *Journal of Education and E-Learning Research*, *11*(2), 422–434. https://doi.org/10.20448/jeelr.v11i2.5676

Syarief, N. S., Pangestu, A. A., Putri, H. K., Filkhaqq, T. A., & Harjanti, G. Y. N. (2022). Karakteristik Dan Model Pendidikan Bagi Anak Tuna Daksa. *Edification Journal*, *4*(2), 275–285. https://doi.org/10.37092/ej.v4i2.337

Tamba Jefri. (2016). Aksesibilitas Sarana dan Prasarana bagi Penyandang Tunadaksa di Universitas Brawijaya. *Ijds*, *3*(1), 16–25.

Tamrin, A. G., Triyono, M. B., Saputro, I. N., Lilo, T., Sucipto, A., & Asnur, L. (2025). Enhancing creative teaching behavior of vocational school teachers : structural equation modeling analysis. *Journal of Education and Learning (EduLearn)*, *19*(1), 221–231. https://doi.org/10.11591/edulearn.v19i1.21812

Taufik, A. N., & Rahaju, T. (2021). Implementasi Kebijakan Pendidikan Inklusif Untuk Mewujudkan Kesetaraan Belajar Bagi Peserta Didik Berkebutuhan Khusus Tingkat Sma Di Surabaya. *Publika*, *9*(3), 139–154. https://doi.org/10.26740/publika.v9n3.p139-154

Widajati, W., Purbaningrum, E., Mahmudah, S., & Anggraeny, D. (2022). Flipped Classroom Dalam Pembelajaran Life Skill Siswa. *JURNAL NUSANTARA OF RESEARCH*, *9*(3), 293–302.

Winarsih, M., Wahyuni, L. D., & Nanik, U. (2019). Identifikasi Kebutuhan Media Pembelajaran Kesehatan Reproduksi Bagi Penyandang Disabilitas Gangguan Pendengaran. *Seminar Nasional Edusainstek FMIPA UNIMUS 2019*, 336–341.

Winarto, W. (2017). Virsag Media Pembelajaran IPA Untuk Siswa Tunadaksa Di Sekolah Dasar. *DIALEKTIKA Jurnal Pemikiran dan Penelitian*, *7*(2).