



## Development of web-based digital Mathematics module grade VII SMPN 1 Watansoppeng

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### ABSTRACT

The development of digital mathematics modules in the digital era offers vital relevance in enhancing learning effectiveness. This research applies the research and development (Rand D) approach to the ADDIE model, which includes five stages: analysis, design, development, implementation, and evaluation. This research aims to holistically identify needs, design, and evaluate the digital modules. The trial respondents are 29 seventh-grade students from SMP Negeri 1 Watansoppeng. The modules are validated by subject matter and media experts. Additionally, based on trial results, the modules are deemed practical due to positive responses from students. Analysis of learning test results shows a significant improvement in post-test scores, and N-gain analysis indicates the effectiveness of the modules in enhancing student understanding. This research concluded that the digital modules are effective and suitable for use in the context of mathematics learning in schools. The digital modules as an alternative have significant potential to enhance the quality of mathematics education, particularly in leveraging digital technology as an effective and relevant learning tool. Using web-based digital mathematics modules developed through the R and D approach with the ADDIE model represents a progressive step in supporting teaching and learning mathematics in the current digital era.

### ARTICLE INFO

#### Article History:

Received: 8 Jan 2024

Revised: 20 Mar 2024

Accepted: 22 Mar 2024

Available online: 26 Mar 2024

Publish: 22 May 2024

#### Keyword:

Digital modules; Mathematics; web-based; website

#### Open access

Inovasi Kurikulum is a peer-reviewed open-access journal.

### ABSTRAK

Pengembangan modul digital matematika di era digital menawarkan relevansi yang vital dalam meningkatkan efektivitas pembelajaran. Penelitian ini menerapkan pendekatan research and development (R and D) dengan model ADDIE, yang mencakup lima tahapan, yaitu analisis, desain, pengembangan, implementasi, dan evaluasi. Tujuan penelitian ini adalah untuk mengidentifikasi kebutuhan, merancang, dan mengevaluasi modul digital tersebut secara holistik. Responden uji coba is 29 peserta didik kelas VII SMP Negeri 1 Watansoppeng, modul ini dinilai valid oleh validator ahli materi dan media. Selain itu, dari hasil uji coba, modul ini dianggap praktis berdasarkan respon positif dari peserta didik. Analisis tes hasil belajar menunjukkan peningkatan yang signifikan pada nilai posttest, dan hasil analisis N-gain menunjukkan efektivitas modul dalam meningkatkan pemahaman siswa. Dari hasil penelitian ini, disimpulkan bahwa modul digital tersebut efektif dan layak digunakan dalam konteks pembelajaran matematika di sekolah. Modul digital sebagai sebuah alternatif yang memiliki potensi besar untuk meningkatkan kualitas pembelajaran matematika, khususnya dalam memanfaatkan teknologi digital sebagai sarana pembelajaran yang efektif dan relevan. Penggunaan modul digital matematika berbasis web yang dikembangkan melalui pendekatan R and D dengan model ADDIE merupakan langkah progresif dalam mendukung pengajaran dan pembelajaran matematika di era digital saat ini.

**Kata Kunci:** Basis website; modul digital; Matematika; website

### How to cite (APA 7)

Rahmawati, S., Nurhikmah H, & Muin, A. (2024). Development of web-based digital mathematics module grade VII SMPN 1 Watansoppeng. *Inovasi Kurikulum*, 21(2), 647-660.

### Peer review

This article has been peer-reviewed through the journal's standard double-blind peer review, where both the reviewers and authors are anonymised during review.

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## INTRODUCTION

Education involves a deliberate and systematic endeavor to cultivate a conducive learning environment and process, enabling students to actively develop their potential in religious, spiritual, self-control, personality, intelligence, noble morals, and essential skills required by themselves, society, and the nation. Attaining learning objectives is facilitated through meticulously designed learning strategies to provide a high-quality educational experience. One effective approach teachers employ to devise such strategies is integrating information and communication technology tools into the teaching process (Salsabila, 2020). Enhancing the quality of education and students' learning experiences in line with process standards necessitates innovative measures. These may encompass elevating the competence of teachers and educational staff, refining the curriculum, fostering learning innovation, and ensuring the adequacy of facilities and infrastructure (Nurhikmah et al., 2021). Teachers lead the learning process, optimizing classroom activities according to students' contemporary needs and characteristics. Hence, teachers are expected to demonstrate regularity, creativity, and consistency in their pedagogical practices (Hutahaen et al., 2022).

Based on the initial data collected at SMP Negeri 1 Watansoppeng during the odd semester of 2023, it was observed that teachers had developed teaching modules aligned with the independent curriculum guidelines. These modules typically include learning objectives, activity sequences, and assessments necessary for a specific unit or topic, following the flow of learning objectives or a predefined time frame. However, despite the availability of these teaching modules, students have not fully utilized them as learning references in class. This is attributed to the limited scope of material covered in the modules. Through interviews with mathematics teachers at SMPN 1 Watansoppeng, it was revealed that there is a need for teaching modules structured according to the flow of learning objectives, accompanied by diverse reading materials. Particularly in mathematics, which often involves abstract concepts, it is crucial to present the material in various formats, not solely relying on textual explanations. Mathematics is perceived as a subject that needs to be comprehended and serves as a conceptual tool for constructing and reconstructing knowledge and refining thinking skills necessary for problem-solving in real-life situations (Purnawanto, 2022). Exclusively relying on verbal and written explanations for learning mathematics can pose difficulties, as some concepts might necessitate visual aids to enhance comprehension. Therefore, using audio-visual application media is beneficial, allowing learners to imagine and visually experience the concepts taught (Puspita, 2022).

Utilizing web-based digital mathematics modules offers students the convenience of accessing the module without being restricted by the storage device used. An advantage of digital modules is their ability to incorporate audio or video elements tailored to students' learning styles at SMP Negeri 1 Watansoppeng. Digital or electronic instructional modules are electronic educational tools that can be divided into tangible learning components and utilized consistently in a self-directed and structured fashion. The benefit of digital teaching modules is the ability to provide text-based learning materials and exercises and include images and videos to support the learning process (Fitri et al., 2023). The novelty introduced by the researchers in this study, setting it apart from earlier research, lies in creating a web-based digital mathematics module corresponding to the self-directed curriculum. This module incorporates learning videos and interactive formative assessments. The learning modules and videos are crafted using the Canva application, enhancing their visual appeal. Additionally, formative assessments via Google Forms are anticipated to enhance learning competencies engagingly and collaboratively, aligning with student-centered learning principles.

Research conducted by [Auliah et al. \(2020\)](#) under the title "Development of Digital Mathematics Learning Modules based on the Open-Ended Approach to Enhance Mathematical Creative Thinking Skills" demonstrates that employing digital mathematics learning modules with an open-ended approach can enhance students' creative thinking skills in mathematics. The digital module crafted in this investigation incorporates animations, audio, and video components; however, its content is solely dedicated to Systems of Linear Equations with Two Variables. In a recent study, [Fitri et al. \(2023\)](#) concluded that digital instructional modules focusing on computer networking and internet utilization, designed using Canva, were highly suitable for integration into the learning process. Unlike the former, the digital module developed in this research solely delivers content through text and images, lacking any audio or video supplementation.

Various studies suggest that utilizing digital modules can serve as an effective and relevant resource in the educational journey, particularly for institutions equipped with robust internet infrastructure. Furthermore, the prevalence of smartphones among students presents opportunities for further advancements in digital module development. The research inquiry in this study revolves around three fundamental queries: Why are Web-Based Digital Mathematics Modules necessary, how can a Web-Based Digital Mathematics Module be devised, and what are the levels of validity, practicality, and effectiveness of the Web-Based Digital Mathematics Module for Grade VII at SMP Negeri 1 Watansoppeng. This study aims to recognize the need for web-based digital mathematics modules for Grade VII students at SMPN 1 Watansoppeng, formulate such a module, and assess its validity, practicality, and effectiveness.

## LITERATURE REVIEW

### Developments in educational technology

In theory and practice, educational technology encompasses the study and ethical application of facilitating learning and enhancing performance through the effective creation, utilization, and management of technological processes and resources ([Asma, 2023](#)). Within educational technology, the term "development" refers to designing, constructing, and implementing educational technology tools or solutions to foster learning and teaching ([Fahma, 2021](#)). The developmental process in educational technology comprises several sequential stages or levels, beginning with the review or analysis stage to identify needs, learning environments, and expected objectives. Subsequently, the design phase involves prototyping, followed by the realization or creation of technological products (commonly referred to as "development"). These educational technology products then progress to the utilization or implementation stage, succeeded by the evaluation stage to gauge effectiveness and identify areas for enhancement. Integrating all these stages forms a cohesive learning or instructional design model ([Nurhikmah et al., 2021](#)).

The development of educational technology draws upon various disciplines, such as instructional design for pedagogical aspects, software engineering for technological aspects, and user experience design for content aspects ([Kewalramani et al., 2020](#)). Therefore, the development of educational technology necessitates collaboration among educators, technology developers, media experts, and other policy stakeholders. Furthermore, educational technology integrates several components, including pedagogical models, technology platforms, and content development. These research findings underscore the importance of considering pedagogical aspects in educational technology development and emphasize the effective integration of technology into the learning and teaching process. To sum up, "development" pertains to the comprehensive process of creating technological solutions to enhance learning and teaching performance within educational technology. This process entails iterative stages and necessitates collaboration among various policy stakeholders. Emphasizing pedagogical aspects

throughout the development process is crucial, alongside assessing its effectiveness in enhancing learning outcomes (Maharani et al., 2023).

## **Digital Module**

Teaching materials refer to systematically organized resources teachers utilize to facilitate classroom learning activities. These materials can encompass written or unwritten content (Misrawati & Suryana, 2021). They play a significant role in shaping students' listening skills during learning sessions. Engaging and well-crafted teaching materials significantly impact students' learning processes and outcomes. Teaching materials must align with students' cognitive levels, and the language utilized should adhere to proper linguistic conventions, ensuring students' clarity and comprehension. Digital modules are self-paced instructional materials designed systematically and electronically for independent study. They offer interactive features, allowing navigation through linked content and enhancing the learning experience. Digital modules can incorporate multimedia formats, such as videos, audio, and animations, enriching students' learning experiences. The characteristics of digital modules are akin to those of printed modules and can be adapted accordingly. Some shared characteristics include self-instructional, self-contained, stand-alone, adaptive, and user-friendly features (Fadilah, 2023).

## **Web-based learning**

Web-based learning, or e-learning, refers to the educational process conducted via the Internet (Fauziah, 2020). The internet, comprising interconnected computers and local networks, facilitates global connectivity. It offers various tools and platforms for educational purposes, such as email, Internet Relay Chat, mailing lists, file transfer protocol, and the World Wide Web. Accessing information sources online is a fundamental requirement for web-based learning. Users must locate the desired information sources, including freely accessible data repositories or authorized databases. Internet technology enables convenient and rapid access to information from diverse sources worldwide. This accessibility is one of the key advantages of web-based learning. However, implementing web-based learning entails more than simply uploading learning materials online for access via computers. The web serves as a digital storage medium and a platform that offers unique advantages over traditional media like paper (Tasmiyah, 2023).

Leveraging these advantages requires a strategic approach to web-based learning to capitalize on the web's interactive capabilities and accessibility. Web-based learning relies on various principles that significantly influence the success of the learning process during its implementation. The effectiveness of web-based learning largely hinges on the perspectives of stakeholders. As a result, pinpointing the essential principles necessary for web-based learning can be challenging (Sujiwo, 2019). Several principles in web-based learning include interaction, dependency, and relevance. From the description mentioned above, the key principles for implementing web-based learning entail fostering interaction between students and instructors within the learning environment utilizing web-based learning. Additionally, there needs to be a sense of dependency, outlining how learning is developed based on the web and fostering a consistent and straightforward learning atmosphere to alleviate students' learning challenges. Moreover, web-based learning must exhibit relevance in delivering specific information to enhance students' comprehension (Fauziah, 2020).

## **Flip PDF Professional**

Flip PDF Professional is a software tool designed to transform PDF files into dynamic digital publications, enhancing visual appeal akin to flipping through a traditional book. It offers several advantages, particularly in user-friendliness, as it can be utilized by novices unfamiliar with HTML programming (Sriyanti, 2021).

This multipurpose flipbook creator allows for page editing and enables the integration of multimedia elements such as images, YouTube videos, MP4 files, audio clips, hyperlinks, quizzes, flash animations, and interactive buttons, resulting in visually appealing and interactive digital products (Seruni et al., 2019). The output generated by Flip PDF Professional can be in various formats, including HTML5, EXE, ZIP, Mac app, FBR, mobile versions, or burned to CD (Rahman et al., 2021). The HTML5 format ensures online interoperability across smartphones and computers, while other formats are suitable for offline manual computer operation.

## METHODS

The relevant research methodology for achieving the stated objectives is Research and Development a research approach utilized to create specific products and evaluate their effectiveness. It is commonly employed in educational technology, particularly in designing and developing systems and materials. R&D research aims to generate meaningful interventions and practices, addressing real educational challenges (Hoadley, 2022). Prior to engaging in development endeavors, thorough research is essential. This research follows the ADDIE development model, comprising five stages: analysis, design, development, implementation, and evaluation. The chosen research location for this developmental study was SMPN 1 Watansoppeng, involving 29 seventh-grade students from class VII.1 as participants. Data collection tools comprised validation sheets, questionnaires, and assessments of learning achievements. The validation sheets were distributed to two lecturers with expertise in material and media, along with a mathematics teacher from SMPN 1 Watansoppeng, acknowledged as an expert in the field. Data gathered from questionnaires were analyzed utilizing descriptive percentages. The formula utilized to compute the percentage for each subject was:

$$Percentage = \frac{\sum (Answer \times score \text{ answer})}{N \times highest \text{ score}} \times 100 \%$$

N represents the total count of questionnaire items.

Moreover, to compute the percentage for all subjects, the following formula was employed:

$$Percentage = F : N$$

*F* = The total percentage of the subject

*N* = Many subjects

The Percentage Results are used to provide answers regarding the success of the learning process from the aspects under investigation. There are five categories of eligibility. This scale considers the range of percentage values. The maximum expected value is 100%, and the minimum is 0%. The collected data is subsequently categorized into groups based on their effectiveness levels, which include highly effective, effective, moderately effective, and minimally effective. The division of eligibility range according to can be seen in **Table 1**.

**Table 1.** Indicators of success of the learning process

No	Score	Category
1	<20%	minimally effective
2	21% - 40%	Less Effective
3	41% - 60%	moderately effective
4	61%-80%	Effective

Source: Matitaputty (2023)

The conversion of achievement levels using a 5-point scale refers to transforming or interpreting assessment results based on a five-point scale. This scale is commonly used in research or evaluations in various fields, such as education. This conversion can be done by considering the range of values obtained within the 5-point scale. Generally, this scale allows for assessing the level of achievement or quality of something from the lowest to the highest. The distribution of importance and decision-making is utilized in the following provisions, which can be seen in **Table 2**.

**Table 2.** Convert the Level of Achievement with a Scale of 5

No	Achievement Level	Qualification	Information
1	90%-100%	Very good	No Need Revised
2	75%-89%	Well	No Need Revised
3	65%-74%	Enough	Revised
4	55%-64%	Not enough	Revised

Source: *Matitaputty (2023)*

It will be deemed valid if the validity test results fall within the 75% - 100% range or the good to very good categories. Similarly, if the practicality test results range between 75% - 100% or fall within the good to very good categories, it will be considered practical. Qualitative research data, such as comments and suggestions, will be used to refine the web-based digital mathematics module. During the product trial phase, students undergo testing, including a pretest before N-gain with the digital module and a post-test after completion. Data from the pretest and post-test results are calculated using the following formula.

$$Nilai = \frac{Jumlah\ benar}{jumlah\ soal} \times 100$$

By analyzing the computed values from the pretest and post-test of each respondent, we utilize the normalized N-gain, as introduced. According to *Fadaei (2019)*, Hake's gain is a tool to gauge the comparative effectiveness of different teaching methodologies. The N-gain can be determined using the subsequent formula for digital module-based learning.

$$N_{gain} = \frac{x_{posttest} - x_{pretest}}{100 - x_{pretest}}$$

Information:

$x_{pretest}$  : the average score of the initial test

$x_{posttest}$  : final test average score

## RESULTS AND DISCUSSION

The research findings delineate the progression in crafting web-based digital mathematics modules, encompassing the prerequisites for digital modules, the design of digital modules, and the validation, practicality, and efficacy of digital mathematics modules. This comprehensive explanation is elucidated as follows.

### Needs Analysis

Analysis includes examining facilities and infrastructure, as well as assessing student characteristics. Following a needs analysis conducted through teacher interviews, various findings emerged: 1) The achievement of mathematics learning in phase D has been analyzed together with mathematics teachers

at the school at each grade level. In addition, mathematics teachers at SMPN 1 Watansoppeng have already formulated learning objectives and the flow of mathematics learning objectives in phase D; 2) Teachers have compiled teaching modules based on ATP, but the reading materials in the modules are still very limited. As a result, the teaching modules have not been maximally utilized by students as a learning resource. The parts of the teaching modules accessed by students are only the assessments and worksheets; 3) The common media used are electronic books in PDF format, PowerPoint, and instructional videos from YouTube. However, the videos taken from YouTube are not entirely aligned with the learning objectives formulated by the teachers; and 4) Teachers' ability to create instructional media such as instructional videos is still limited. Moreover, creating instructional videos requires much time, and since teachers have a heavy teaching workload at school, they do not have enough time to create instructional videos.

### **Mathematics Digital Module Design**

The design phase commences with an examination of learning outcomes, the assembly of learning objectives and their sequence, the creation of scenarios or instructional activities, gathering reference materials, installing necessary applications such as Flip PDF Professional, and specifying the elements to be incorporated like color schemes, text formatting, images, audio, and video. These elements will be integrated to form the foundational visual layout of the digital mathematics module. Compiling material for the digital mathematics module, the material chosen is class VII material, which contains material on integers, rational numbers, ratios, and algebraic forms. The reference sources for the material used are mathematics concepts and applications books published by the National Ministry of Education, and mathematics books published by the Ministry of Education and Culture, Research and Technology. After the material has been collected. Next, digital modules are created using the application Flip PDF Professional. The initial stage of creating a digital module is designing the background and module components using Canva.

After all the material has been designed properly, the next step is to import the Canva results into a form PDF and the result of the Back import into Flip PDF Professional. We include the learning videos made previously Flip PDF Professional by adding a hyperlink to go to the previously created video location shortcut. Using Flip PDF Professional in making this digital module aligns with research conducted by [Yulia \(2021\)](#). Flip PDF Professional is an application that can convert PDF page publications digitally, allowing us to create interactive learning content with several supporting features. Flip PDF Professional is different from PDF, which is usually used. Regarding appearance, Flip PDF Professional is like a lookbook that can be flipped back and forth while reading it. Comparing the findings from the design phase with [Yulia \(2021\)](#), which highlights the utility of Flip PDF Professional for crafting interactive learning materials, aligns with the conclusions drawn by previous researchers. They advocate for using Flip PDF Professional in digital module design because it enhances PDFs' visual appeal, rendering them akin to flip-over modules, thereby offering a more engaging reading experience.

### **Mathematics Digital Module Design**

In the ADDIE model, the design phase involves creating a digital module product to be developed. The initial step is media selection, which aims to choose media that aligns with the material's characteristics to facilitate achieving learning goals. The chosen media is a web-based digital module designed using the Flip PDF Professional application. The next step is to prepare the material according to the teaching module. This involves developing eight module units covering topics on number and algebra elements. Additionally, developers prepare student worksheets and assessments to be integrated into the digital mathematics module. The third step is the initial planning phase, which includes outlining the media plan

for the development process. This initial plan creates a prototype digital module to be further developed in subsequent stages. The designed digital module at this stage is web-based and tailored to students' preferences for materials supplemented with learning videos. The design/prototype of the digital mathematics module is described as follows.

1. Specification: This digital module uses the software application Flip PDF Professional;
2. Design/template: Before the material is extracted into Flip PDF Professional application, a template is first created using Canva;
3. Content/material design: The material is first created in Canva and then exposed to PDF. Next, the file or material is entered into the software Flip PDF Professional and published in the form html5. Then, the module in HTML form is uploaded to the web using Netlify;
4. Visual design using Canva to create an attractive design for digital module users;
5. Body frame consists of a cover, foreword, table of contents, instructions for using the module, general information, core components, attachments, and bibliography

The fourth step is compiling a research instrument. The instrument is used as a tool for collecting data in order to solve a research problem.

### **Analyze the Validity, Practicality, and Effectiveness of Digital Modules**

The evaluation of the digital mathematics module's validity in this study followed the development phase as per the ADDIE model. Researchers conducted the development stage to ensure the resulting product was validated. Before assessing the validity of the interactive learning multimedia, learning tools and materials were developed to generate digital module products. The validation results of the digital mathematics module by content experts obtained a percentage of 94.29%, while design and media experts reached 99.13%, both meeting the validation criteria. After conducting validation tests, revisions were implemented based on expert feedback and suggestions. One of the revisions made to the digital module involved adjusting the color of the tools in the Flip Digital Module template to ensure readability when displayed on the web or Google Slide. Additionally, material experts provided input, suggestions, and comments on the digital mathematics module, particularly regarding the assessment table. Specifically, they suggested placing the criteria points for achieving the goals after the learning objectives. This feedback was addressed by reviewing the display of the digital modules in each unit and ensuring alignment of learning activities, student worksheets, and all materials and videos with the learning objectives. After completing the development stage, the digital mathematics module was implemented in the subsequent phase.

The product's practicality was evaluated during implementation through teacher response questionnaires to collect feedback on program performance and user experiences with the digital mathematics modules. These assessments encompassed various aspects, including the learning process, presentation quality, module components' usefulness, and curriculum alignment. According to the responses gathered from the mathematics teacher questionnaire, the product attained a score of 91.7%, indicating a high level of practicality. Subsequently, the practicality test involved nine students from class VII.1, divided into three groups, each comprising three students. The average percentage of these nine students' digital mathematics module products was 84.9%, indicating overall good qualifications. Therefore, there was no need for revisions to the products in this digital mathematics module. The effectiveness of the digital mathematics module was assessed through a pretest conducted with 29 students from class VII.1 at SMPN 1 Watansoppeng to measure their initial knowledge level of algebraic operations before using the digital mathematics modules. Students completed a post-test to evaluate their knowledge levels after participating in learning activities with the digital modules. The pretest results revealed an average score



of 46.03% among the 29 students at SMPN 1 Watansoppeng, indicating their initial understanding of the subject matter.

**Table 3.** Recapitulation of Pretest Results

No	Score	Category	Number of Respondent
1	< 20%	Very Less Effective	2 participants
2	21% - 40%	Less Effective	11 participants
3	41% - 60%	Enough Effective	11 participants
4	61% - 80%	Effective	5 participants
5	81% - 100%	Very Effective	0 participants

Source: *Research Findings 2024*

Based on the data presented in **Table 3**, it is apparent that many students encounter difficulties in understanding algebraic operations concepts. Consequently, there arises a need for interventions aimed at enhancing comprehension and thereby improving proficiency in this subject area. As a result, students are engaged in the learning process utilizing digital mathematics modules. The effectiveness of the digital mathematics module can be seen from the pretest learning outcomes test conducted in class VII.1 SMPN 1 Watansoppeng with 29 students as respondents before undergoing the learning process using the digital mathematics module. This aims to measure students' prior knowledge related to the material of algebraic form operations before learning. After the students have participated in learning using the digital mathematics module, they then take a posttest to measure their level of knowledge. The average pretest score was 46.03, and the average posttest score was 78.28. These findings indicate a notable improvement in students' post-test scores after engaging with web-based digital mathematics modules. The effectiveness evaluation is gauged through the "Tune" metric, derived from the disparity between pretest and posttest average scores.

Based on calculations, the N-gain value obtained was 0.59, categorized as moderate. This indicates that web-based digital mathematics modules have a fairly effective impact on student learning outcomes. The improvement in student scores from pretest to posttest indicates that digital modules can help students improve motivation, thus affecting their knowledge and ultimately increasing their learning outcomes. The significant improvement between pretest and posttest scores experienced by students varies according to their interaction with the digital module. However, overall, the influence of the developed digital mathematics module can assist students in understanding the material concepts.

## Discussion

The creation of a web-based digital mathematics module aimed at enhancing the learning comprehension of Grade VII students in Mathematics at SMPN 1 Watansoppeng has completed all procedural phases. This digital module is envisioned to reinforce understanding of mathematical concepts related to numbers and algebra while providing a fresh learning environment for students facing participation constraints. This digital module is also anticipated to optimize the learning experience by leveraging technology. The impetus for developing a digital mathematics module in this study stemmed from analyzing students' requirements for such modules. Following this, the developer thoroughly examined material needs, revealing students' struggles with comprehending mathematical concepts. Data from mathematics teachers indicated that a significant portion of Grade VII students encountered difficulties with numerical and algebraic operations. Concurrently, insights into students' digital module necessities highlighted a demand for learning resources featuring instructional videos offering lucid explanations and playback capabilities.

Digital modules have broad benefits, especially in mathematics lessons, as they can be used as instructional media in the classroom or as self-learning media. The output of the product produces digital modules that can be accessed on laptops, computers, or smartphones. The use of modules in digital format indeed has advantages in terms of accessibility. Accessibility (ease of use) has a more significant impact in determining media choices than teaching effectiveness. The developed digital mathematics modules can be accessed flexibly and conveniently by users because they can be opened through available electronic devices. This allows learners to study whenever they want, outside the classroom or during scheduled learning hours (Francisco, 2020).

Digital mathematics modules are not limited to textual content and images; they also incorporate video presentations discussing the material. Moreover, the digital module's design elements, such as color schemes, backgrounds, hyperlinks, and animated movements, effectively capture students' attention. This aligns with Alim (2023), which advocates integrating multimedia elements like audio, video, animation, and hyperlinks into learning materials, enabling users to control navigation and engage with the material independently. Students can navigate freely, watch, pause, and replay video content embedded in the digital mathematics module. Nurhikmah (2020) also explains that multimedia utilizes computers to combine text, graphics, audio, and moving images, facilitating easier navigation, interaction, creation, and communication. Thus, when teachers incorporate multimedia elements into their teaching, including initial, core, and concluding activities, it enhances the learning experience for students. Accordingly, using text, images, videos, and animations in this digital mathematics module is tailored to meet students' needs, thereby assisting teachers in teaching and learning.

Comparing the needs analysis findings with the studies by Alim (2023) and Nurhikmah (2020), it is evident that incorporating text, images, and videos into digital modules leads to engaging and easily comprehensible information for students. This corresponds with research outcomes, indicating that students prefer digital modules accompanied by instructional videos as they facilitate independent learning, whether in the classroom or at home. The design phase commences by analyzing learning outcomes, outlining learning objectives and their sequence, creating scenarios or instructional activities, gathering reference materials, and installing necessary applications, such as Flip PDF Professional. Additionally, decisions are made regarding the elements to be incorporated, including color schemes, text formatting, imagery, audio, and video. These elements are interlinked to establish the foundational layout for the digital mathematics module.

Curating content for the digital mathematics module involves selecting materials relevant to the Grade VII curriculum, encompassing integers, rational numbers, ratios, and algebraic expressions. The chosen resources include mathematics textbooks on fundamental concepts and applications published by the National Department of Education and those released by the Ministry of Education, Culture, Research, and Technology. Once the materials are compiled, the digital modules are developed using the Flip PDF Professional application. The initial phase entails designing the module's background and components using Canva. Subsequently, the designed elements from Canva are imported into a PDF format, which is then imported into Flip PDF Professional. Additionally, learning videos are integrated into the module by incorporating hyperlinks to previously created video locations. Utilizing Flip PDF Professional aligns with the findings of Yulia (2021), which highlights its capability to convert PDF pages into interactive digital publications, facilitating the creation of engaging learning content with various supportive features. Flip PDF Professional distinguishes itself from conventional PDFs by presenting content in a format akin to flipbooks, allowing for easy navigation and interactive reading experiences.

Drawing from the outcomes of the design phase and juxtaposing them with Yulia (2021) research findings, it is evident that employing Flip PDF Professional for crafting digital books enables the generation of interactive learning materials. This concurs with prior research, affirming the selection of Flip PDF

Professional for designing digital modules, as it facilitates transforming PDFs into visually appealing formats resembling flipbooks, enhancing engagement by allowing for interactive navigation during reading.

The assessment of the validity, feasibility, and efficacy of the digital mathematics module products involved validation by two experts—material specialists and media experts—along with individual, small group, and large group testing, incorporating diverse stakeholders to evaluate effectiveness and gauge teachers' responses regarding the module's practicality. The findings indicate that the digital mathematics module products are validated, practical, and effective, as determined by a collaborative effort between material and media experts and feedback from Grade VII students at SMPN 1 Watansoppeng.

The mathematics subject teacher evaluated practicality, assessing aspects such as the utility of digital modules, presentation quality, and the functionality of digital module components. The responses received were highly favorable, indicating the practicality of the modules for educational use. Similarly, practicality was assessed through small group testing involving three groups of Grade VII students (Triwahyuningtyas, 2020). The results, also deemed satisfactory, indicate that the product requires no revisions. The final phase involves assessing the effectiveness of the developed mathematics module, conducted on a large scale. Pretest and post-test scores are analyzed to evaluate effectiveness, primarily through the N-gain results. The digital mathematics module focusing on algebraic operations has been fairly successful, exhibiting a medium level of effectiveness. Students' responses to the digital mathematics module serve as a gauge for its effectiveness, falling within the medium category. The efficacy of the developed digital modules is influenced by visually appealing images, legible text, and instructional videos, which aid students in comprehending the material more easily (Putri, 2020).

Through the validation, effectiveness, and practicality testing, a digital mathematics module teaching material has been developed, meeting the validity, effectiveness, and practicality criteria per various theories. This achievement is a valuable tool aiding the learning evaluation process, positively influencing students. These findings resonate with the research conducted by Qamariah (2023) titled "Development of Professional Flip PDF Based E-Modules on Fractional Material," which underscores the creation of electronic modules or digital modules using Flip PDF Professional, which are visually appealing and enhance students' theoretical understanding and interest, particularly in fractional material at the elementary school level. From the previous discussion, it can be inferred that digital mathematics modules offer several benefits, including 1) Accessibility via gadgets, computers, or laptops without the need for device storage; 2) Customization of text, images, videos, and animations to suit students' needs; 3) Integration of text, images, and videos within the digital module; 4) Demonstrated effectiveness in enhancing student learning outcomes, as evidenced by pretest and post-test results measured by N-gain. However, alongside these advantages, there are certain limitations in the development of digital modules, such as 1) the inability to access the digital module offline and 2) the inability of students to directly fill in worksheets within the digital module.

## CONCLUSION

Based on the research results and discussion on the development of web-based digital mathematics modules at SMPN 1 Watansoppeng, it can be concluded that the analysis of needs obtained through questionnaires filled out via Google Form by seventh-grade students at SMPN 1 Watansoppeng shows that students need digital modules equipped with instructional videos. This result serves as a reference in developing web-based digital Mathematics modules. The design development of digital Mathematics modules is designed according to the flow of learning objectives, materials, and themes are designed with Canva and exported in PDF format, then inserted into the Flip PDF Professional application to be equipped with hyperlinks in the table of contents, images, and videos inserted according to the characteristics of the material. The modules in Flip PDF Professional format are published in HTML5 format and then uploaded

to the web using Netlify. This digital teaching material can be accessed online using laptops, computers, or smartphones. Web-based digital Mathematics modules show that the modules, piloted with students and assessed by Mathematics teachers, are valid, practical, and effective. The recommendations derived from the researchers' study are as follows: Teachers are encouraged to employ the developed digital mathematics modules, particularly in teaching numerical concepts and algebra, to enhance the learning process, and participants are advised to utilize the developed digital modules as supplementary resources in their mathematics learning endeavors to fulfill learning objectives effectively, future researchers are encouraged to use the development process of digital mathematics modules as a reference for creating other digital modules or improving existing digital mathematics modules.

### **AUTHOR'S NOTE**

The authors declare that there is no conflict of interest regarding the publication of this article. The author confirms that the data and content of the article are free from plagiarism.

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