THE DEVELOPMENT OF "KOMLABIL" (KOMIK POLA BILANGAN) MEDIA IN LEARNING NUMERICAL PATTERNS

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Abstract: In the era of globalization, marked by the rapid development of technology, various innovations continue to emerge, including in the education sector. The application of digital transformation in education involves the use of information and communication technology to impact the improvement of learning quality, expand access to learning resources, and create a more interactive and collaborative learning environment. Thus, the education sector has become one of the most responsive fields to technological advancements. This study developed a learning media in the form of comics, named "Komlabil," using i-Spring Suite software on the material of numerical patterns. This media was designed following the PLOMP development model which includes five main stages: Preliminary Investigation, Design, Realization/Construction, Test, Evaluation and Revision, and Implementation. The research subjects were 27 eighth-grade students at SMP Negeri 1 Bulawa. This study revealed that digital comic media has been declared valid and practical. Through evaluation by media and material expert validators, an average score of 3.27 was obtained from the media expert evaluation and 3.34 from the material expert, both of which fall into the valid category. This indicates that the developed digital comics meet the expected quality standards, both in design and material content, making it suitable to be used as a supporting tool in learning. The percentage of student and teacher responses obtained 92.37% with a strongly positive category and 89% with a practical category. Based on these findings, the developed learning media is considered suitable to be used in teaching and learning activities because it meets the predetermined criteria of validity and practicality. Thus, this learning media not only meets rigorous academic standards but also contributes significantly to improving the quality of the learning process

Keywords: digital comics; i spring suite; plomp method

Introduction

Education is a lifelong learning process that exerts a positive influence on all living beings (Annisa, 2022). It is categorized into two main types: formal and nonformal. Both types of education continue throughout a person's life, aiming to develop individual capacities so that they can contribute effectively to society. In the realm of formal education, mathematics is one of the core subjects studied.

Mathematics is a fundamental discipline, introduced from the earliest stages of education to cultivate a robust understanding of numerical concepts and logical reasoning in students. In everyday life, mathematics plays a pivotal role as it is synonymous with numerical patterns. However, reality often reveals that mathematics is perceived as a challenging subject. This perception leads to a decline in students' interest and motivation towards mathematics, which can negatively impact their academic

achievement in this field. Consequently, effective teaching methods are crucial to ensure students' comprehension of the material as explained by the teacher (Rohman, Syaifudin, 2021). An initial analysis at SMP Negeri 1 Bulawa indicates that students often have a limited interest in mathematics. This condition is evident in the teaching process, which has not been effective enough to capture students' attention. Consistent with findings in (Pauweni et al., 2022), students generally perceive mathematics as difficult and intimidating. This highlights the need for more innovative and engaging teaching methods to enhance students' interest and motivation in learning mathematics. This presents a challenge for teachers to create enjoyable learning experiences that can even alleviate students' fear or apathy towards mathematics (Ibrohim et al., 2024).

The dynamics of globalization demand that the educational sector actively and creatively enhance the effectiveness of learning by integrating information and communication technology. The aim is to advance the quality of education (Salsabila & Agustian, 2021). M-learning systems (mobile learning) have emerged as part of the development of information and communication technology implemented in educational settings. The term m-learning refers to learning systems that utilize information technology devices such as mobile phones, laptops, and others (Sari & Priatna, 2020). M-learning offers numerous benefits in education, one of which, as explained in (Warsita, 2018), is the ability to facilitate learning anytime and anywhere, providing engaging and enjoyable learning experiences. M-learning offers students the convenience of learning at their own pace, enabling them to access learning materials whenever and wherever they want without limitations of time and place. This makes the learning process more flexible and adaptable to individual needs, thereby enhancing accessibility and efficiency in knowledge acquisition. Consequently, m-learning plays a significant role as one of the primary factors in teaching and learning activities in today's modern education.

In the evolution of contemporary education, educational media plays a pivotal role as a supportive tool in the teaching-learning process. These media not only stimulate students' curiosity and motivation but also facilitate comprehension of the material being taught. The effective utilization of instructional media can be a crucial strategy in enhancing the quality of education by delivering engaging and interactive information ((Ramadhani et al., 2024) (Syabrina & Sulistyowati, 2020)). Interactive media encourage students to be active and prevent them from becoming easily bored during learning activities ((Qiftiyah et al., 2024), (Fauzan & Nuriadin, 2023)). The integration of comics into the learning system is an efficient process for fostering students' learning interest (Muliling et al., 2023). As times have evolved, the current generation exhibits a strong affinity for comics. This is due to the fact that comics are a medium for conveying messages through a visually appealing combination of images and text.

In (Sa'diyah Auliyana Ni'mah, 2016) there are five advantages of using comics in education. One of these advantages is that the integration of comics into the learning process has proven to be a powerful strategy for encouraging active participation and learning enthusiasm among students. This medium serves as a supplemental tool in addressing students' learning difficulties (Listianingsih et al., 2021), (R. Anesia, B. S. Anggoro, 2018) and facilitates the delivery of instructional content in a more engaging and interactive manner, thereby effectively enhancing students' participation and comprehension. Additionally, comic media can inspire students and shape their character (Hasanah et al., 2022). Integrating comics into educational activities can create a joyful and happy learning atmosphere for students. The combination of engaging images and text in comics offers a delightful learning experience and simultaneously increases students' learning interest. This is in agreement with (Putra & Milenia, 2021), which suggests that the use of comics can reduce students' boredom with learning, such as the use of comics in mathematics education, which can be employed by combining visualized images within boxes or speech bubbles containing symbols to convey mathematical problems.

Findings from observations and interviews with mathematics teachers at SMP Negeri 1 Bulawa indicated a dearth of effective instructional media within the teaching and learning process. Students predominantly rely on traditional, passive learning approaches that prioritize rote memorization of

teacher-provided formulas, often lacking a deep conceptual understanding. The limited implementation of innovative and interactive instructional media has resulted in suboptimal learning outcomes, failing to adequately stimulate students' interest and facilitate conceptual comprehension. Furthermore, interview findings highlighted challenges related to the topic of numerical patterns, revealing that many students struggle with grasping the concepts and applications of numerical patterns. The integration of appropriate interactive media can create a conducive learning environment and foster increased student engagement in learning activities. By leveraging effective instructional media, teachers can facilitate students' interpretation of concepts and ideas, ultimately enhancing their understanding of the subject matter (Machmud et al., 2023).

To address these challenges, an innovative approach is warranted to enhance students' learning enthusiasm. A proposed solution involves the development of an interactive digital comic as a learning medium, accessible via Android devices, to facilitate the learning of numerical patterns. The developed medium is designed using i-Spring Suite software, a user-friendly tool that integrates seamlessly with PowerPoint, thereby simplifying its use. i-Spring Suite's intuitive interface and user-friendly programming language make it an accessible tool for educators, even those without extensive technical expertise, to create engaging and interactive instructional media (Nabila et al., 2023).

The developed instructional media is aptly named "Komlabil," a abbreviation of "Komik Pola Bilangan" (Numerical Pattern Comic). The researcher aims to leverage this digital comic-based instructional medium to motivate students' engagement in mathematics learning. Additionally, this research seeks to design a valid and practical digital comic-based instructional medium for the topic of numerical patterns, utilizing i-Spring Suite software and adhering to established design principles

Method

SMP Negeri 1 Bulawa served as the research site, with 27 eighth-grade students participating. To develop the product, the researcher employed Plomp's development model, which consists of the following stages: preliminary investigation, design, realization/construction, test, evaluation, and revision, as outlined by ((Palupi et al., 2021), (Dewi et al., 2023)). The Plomp development model was chosen due to its structured and comprehensible framework.

The steps of the Plomp development model were adapted for the development of the instructional media (Wardhani, 2024). The preliminary investigation phase played a crucial role in this research by gathering and analyzing information about the learners, learning needs, and curriculum, providing a foundation for designing targeted instructional media. The design phase involved creating a design plan that included the selection of technology/software, content design, flowchart design, storyboard design, lesson plan development, and research instrument design. The realization/construction phase involved further development of the design phase, resulting in a prototype I, with the output being an Android application. The test, evaluation, and revision phase involved validating and revising the product based on the assessment of media experts. The final phase, implementation, involved the deployment of the media after it was deemed valid and practical.
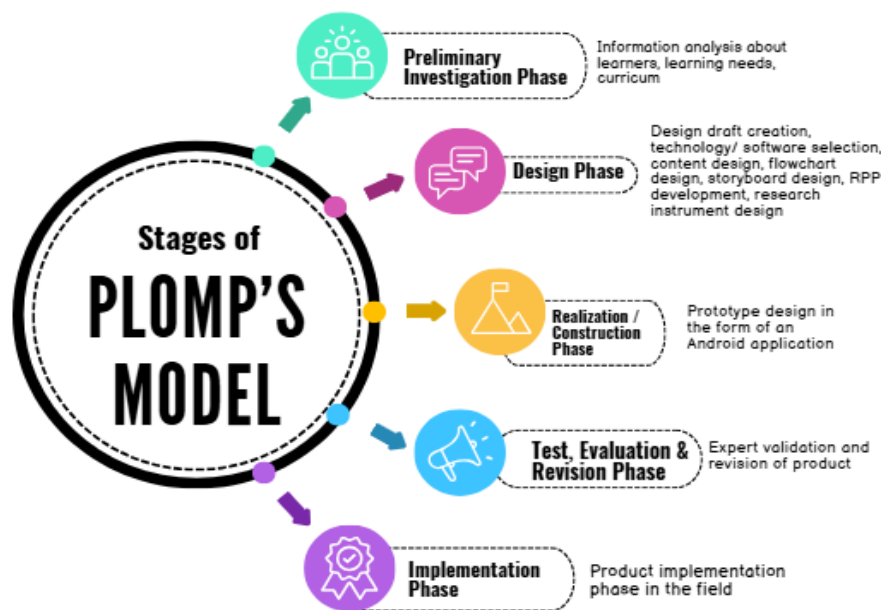
Figure 1. Stages of Plomp's Model

Expert validation sheets, teacher response sheets, and student response sheets were the instruments used for data collection. A Likert scale (Sugiyono, 2015), as presented in Table 1, was used as a reference for assessing the validity of the instructional media.

Table 1. Likert Scale Asssessment

Score	Criteria
4	Strongly Agree
3	Agree
2	Undecided
1	Disagree
0	Strongly Disagree

Subsequently, the obtained data was calculated to determine the average score for each item using the formula:

$$Average\ score = \frac{\sum_{i=1}^{n} X_1}{m}$$

Explanation:
X_1 = Score of the i-th validator
m = Number of validators

After receiving the validation results from the experts, the data was evaluated using the calculation formula described below:

$$SKR = \frac{average\ total\ score}{multiple\ aspects}$$

Subsequently, the obtained scores were converted into qualitative values based on the validity criteria presented (Murtafiah et al., 2021) in Table 2.

Table 2. Standards for Media Validity

Interval Score	Criteria
$x > 3,40$	Strongly Valid
$2,80 < x \leq 3,40$	Valid
$2,20 < x \leq 2,80$	Modarately Valid
$1,60 < x \leq 2,20$	Slightly Valid
$x \leq 1,60$	Invalid

Explanation:

x = average validation scores

To be considered valid, the instructional media must have an average expert validation score that falls within the range of the minimum to maximum validity criteria.

The Likert scale (Sugiyono, 2015) in Table 3 serves as the instrument for measuring the practicality of the digital comic based on the responses of teachers and students collected through a questionnaire.

Table 3. Likert Scale Asssessment

Score	Criteria
4	Strongly Agree
3	Agree
2	Undecided
1	Disagree
0	Strongly Disagree

Subsequently, the data from the student response questionnaires were analyzed using the formula:

$$RP = \frac{obtained\ score}{maximum\ score} \times 100\%$$

Explanation:

RP = response presentation

Subsequently, the percentages were converted into categories of student responses (Yamasari, 2010) as shown in Table 4.

Table 4. Interpretation of Student Feedback

Score	Criteria
$85\% \leq R$	Strongly Positive
$70\% \leq R < 85\%$	Positive
$50\% \leq R < 70\%$	Slightly Positive
$0\% \leq R < 50\%$	Not Positive

If 70% of students respond positively, it indicates a positive response in the positive category (enjoyable, interesting, clear, and engaging) for each targeted component.

The following formula was utilized to analyze the teacher responses:

$$RP = \frac{obtained\ score}{maximum\ score} \times 100\%$$

Explanation:

RP = response presentation

The scores obtained from the teacher's evaluation of the media were matched against the practicality criteria for instructional media (Ferdiansyah et al., 2021) as presented in Table 5.

Tabel 5. Practicality Criteria

Achievements (%)	Category
90% − 100%	Highly practical
80% − 89%	Practical
65% − 79%	Moderately practical
55% − 65%	Slightly practical
0 − 54%	Impractical

A learning medium can be classified as practical if it fulfills the criteria of being evaluated as practical by teachers and eliciting a positive response from learners, as supported by (Murtafiah et al., 2021).

Results and Dsicussion

As a result of this research, an Android-based learning media named "Komlabil" was developed for the topic of Numerical Patterns. The PLOMP development model served as the foundation for this research.

The initial investigation phase involved analyzing a problem concerning the need for information. It revealed that many students lacked enthusiasm for mathematics due to its perceived boredom. The limited use of interactive learning media by teachers and the one-way teaching style were identified as primary factors, leading to student passivity in learning, particularly in the topic of numerical patterns. Additionally, it was found that students had a keen interest in smartphone-based learning and were proficient in using them (Ramadhani et al., 2024). According to (Fitri et al., 2022), the use of smartphones among students has a positive impact on their learning motivation. Consequently, a digital comic learning media was developed to facilitate student learning. Explained (Putra & Milenia, 2021) that the use of comics in learning is considered effective as it stimulates student interest.

In the design phase, the researcher developed an initial design for the media. This included selecting technology, designing content, creating flowcharts and storyboards, developing lesson plans, and designing research instruments. Software such as Microsoft PowerPoint, Canva, Pixton, i-Spring Suite, and Website 2 Apk Builder were utilized. The selection of these software tools was based on their ease of use and accessibility to educators without requiring specialized skills (Zahwa & Syafi'i, 2022).

The realization/construction phase involved implementing the design components using Microsoft PowerPoint, integrated with i-Spring Suite to produce a flash (HTML) format. Subsequently, the flash media was converted into an Android application using Website 2 Apk Builder. This software enabled the transformation of files into Android applications (Hadi, 2020). This phase resulted in Prototype I, as depicted in the following figure.
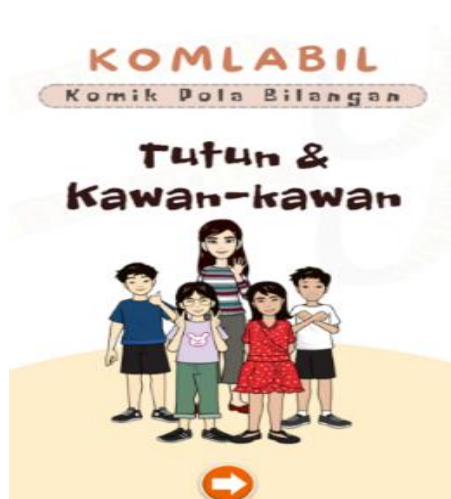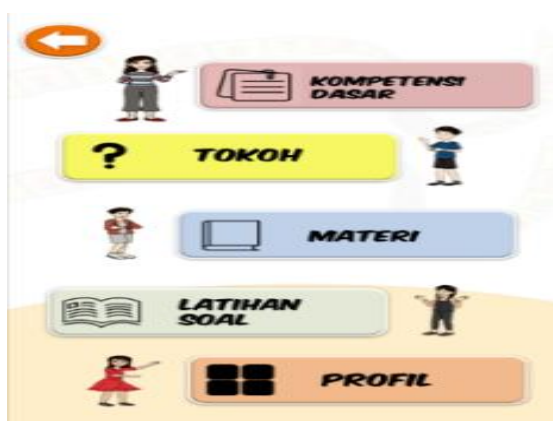
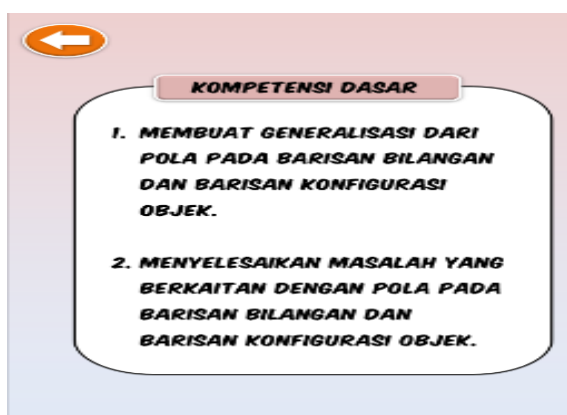**Figure 2. Initial Display**

Figure 3. Display Menu

Figure 4. Core Competency Display

Figure 5. Character Display

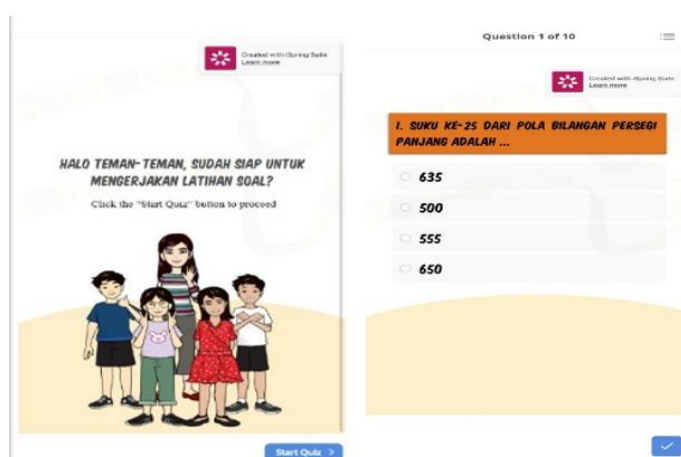**Figure 6. Material Display**

Figure 7. Exercise Display

Testing, Evaluation, and Revision Phase: In this phase, the researcher produced a media which was then validated by media and material experts, resulting in revisions as shown in Table 6.

Table 6. Suggestions and Correction

Suggestions for Improvement	Correction
Media Expert	
The validator recommended using proper and correct Indonesian language.	The dialogue between characters has been corrected to use appropriate Indonesian language.
The validator recommended adjusting the font size to fit within the speech bubbles.	The font size has been corrected to correspond with the size of the speech bubbles.
The validator recommended that the selected answer should change color.	The color of the selected answer has been adjusted.
Subject matter expert	
The validator recommended adding sample questions to each topic discussed.	Sample questions have been added to each topic discussed.
The validator recommended adding dialogues between characters to the discussion of the material.	The dialogues between characters have been added to the discussion of the material.
The validator recommended providing a score at the end of each practice exercise.	A score has been provided at the end of each practice exercise.
The validator recommended adding one example and practice question that involves a contextual problem.	An example and ... extual problem have b... added.

The three media experts who validated the media gave scores of 3.08 (Valid) for the appearance aspect, 3.58 (Strongly Valid) for the functionality aspect, and 3.16 (Valid) for the instructional design aspect. Thus, the total average score obtained from the media experts' validation was 3.27, categorized as "Valid".

Similarly, the media also met the material validity criteria as validated by the material experts. The scores obtained for the content suitability aspect were 3.08 (Valid), for the construction aspect 3.22 (Valid), for the language use aspect 3.66 (Strongly Valid), for the text use aspect 3.58 (Strongly Valid), and for the appearance/text aspect 3.16 (Valid). Thus, the total average score obtained from the material experts' validation was 3.34, categorized as "Valid".

The implementation phase was the stage where the comic media was applied in the learning process after the researcher ensured that the media met the eligibility criteria. The practicality level of the digital comic learning media was evaluated by the researcher through this stage, considering the results of student and teacher response questionnaires. The digital comic learning media received a very positive response from 92% of students. Meanwhile, 89% of teachers rated the digital comic learning media as "very practical".

The findings of this study are in line with Rahmawati's research on "Development of Pythagoras Theorem Learning Media using E-Comic with the help of Pixton". The study showed an average score of 3.1 for media experts (proportion of 77.5%) and a total average score of 3.07 for material experts (appropriate proportion). Student responses were also very good, with a total average score of 3.43 (proportion of 85.97%) (Rahmawati et al., 2023). Thus, it can be said that comic media is an alternative that can be used in the learning process because this media is interesting for students and can increase their motivation to learn mathematics.

Conclusion and Recomendations

The digital comic-based learning media, "Komlabil," has been validated as feasible based on the evaluation of media and material experts, with average scores of (3.27) and (3.34), respectively. The practicality of this learning media has been tested with a student response score of 92.37% (highly positive category) and a teacher response score of 89% (highly practical category). These research findings indicate that the developed "Komlabil" comic media can be implemented in the learning process and serve as an alternative option to increase students' interest and focus, especially in learning numerical patterns. For future research intending to conduct similar studies, it is recommended to conduct larger-scale trials to examine the effectiveness of the developed learning media.

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