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DEVELOPMENT OF FLAT-BUILT DIGITAL COMIC MEDIA BASED ON ETHNOPEDAGOGY OF LOWER CLASS PRIMARY SCHOOL STUDENTS

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Abstract
Meaningful and enjoyable learning is a strategy developed by teachers to optimize learning objectives. This strategy encompasses various aspects, including the approach used, material delivery, engaging instructional media, and creating a pleasant learning environment. The research was conducted using the Research and Development (R&D) approach, commonly known as development research that results in a product. The purpose of this study was to develop a digital comic-based flat geometry learning media grounded in ethno-pedagogy to enhance elementary school students' mathematical connections in lower grades. The ADDIE model. The research outcomes, based on expert validation and field testing, indicate that the digital comic-based flat geometry learning media grounded in ethno-pedagogy aligns well with usability, appropriateness, accuracy, and suitability. The expert validation resulted in an 86% score, with an average material expert score of 96%, categorized as 'Highly Suitable.' Additionally, the language experts provided an average score of 82.5%, categorized as 'Suitable.' Overall, the combined scores from the experts yielded an 88.16% rating of 'Highly Suitable' for use with elementary school students. Based on the effectiveness test, the digital comic-based flat geometry learning media grounded in ethno-pedagogy demonstrated a positive impact on mathematical connections. The N-Gain calculation resulted in an average N-Gain score of 0.7061, categorized as High."
Keywords: *Development of Media, Digital Comics, Ethnopedagogy, Mathematical Connections*

Abstrak
Pembelajaran bermakna dan menyenangkan merupakan strategi yang dikembangkan guru untuk mengoptimalkan pencapaian tujuan pembelajaran, baik dari segi pendekatan yang digunakan, penyampaian materi dan bahan ajar, media pembelajaran yang menarik, atau membangun lingkungan belajar yang menyenangkan. Penelitian ini dilakukan dengan menggunakan pendekatan R & D (Research and Development), lebih dikenal dengan penelitian pengembangan yang menghasilkan suatu produk. Tujuan penelitian ini dalam rangka mengembangkan media komik digital bangun datar berbasis etnopedagogi untuk meningkatkan koneksi matematika siswa sekolah dasar kelas rendah. Tahapan yang digunakan adalah model ADDIE. Hasil penelitian berupa penilaian validasi uji ahli dan uji lapangan menunjukan bahwa media komik digital bangun datar berbasis etnopedagogi untuk meningkatkan koneksi matematika siswa sekolah dasar kelas rendah sesuai dengan aspek kegunaan, kelayakan, ketepatan dan kepatutan. Skor yang diperoleh dari hasil validasi uji ahli media 86% dan skor rata-rata ahli materi sebesar 96%, untuk ini score dikategorikan "Sangat Layak". Selain itu, Skor rata-rata dari ahli bahasa sebesar 82,5% dengan kategori "Layak". Perolehan nilai keseluruhan dari para ahli tersebut media komik digital bangun datar berbasis etnopedagogi diperoleh sebesar 88,16% dengan kategori "Sangat Layak" digunakan untuk peserta didik kelas rendah sekolah dasar. Berdasarkan hasil uji efektivitas pengembangan media pembelajaran bangun datar berbasis etnopedagogi dinyatakan ada pengaruh positif media komik digital bangun datar berbasis etnopedagogi dengan koneksi matematika. Hasil perhitungan nilai N-Gain menunjukkan bahwa pada penelitian ini mendapatkan skor rata-rata N-Gain sebesar 0.7061 atau dalam kategori tinggi.
Kata Kunci: Pengembangan Media, Komik Digital, Etnopedagogi, Koneksi Matematika

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Introduction

Teachers should maximize learning by utilizing technology, for example, by providing training and familiarizing educators with technology usage. This way, an academic environment aligned with the Fourth Industrial Revolution can be effectively achieved (Setiawan et al., 2019). Meaningful and enjoyable learning is a strategy that teachers develop to optimize learning objectives. This includes the approach used, material delivery, engaging instructional media, and creating a pleasant learning environment (Tisza & Markopoulos, 2021).

Initial observations and interviews conducted by researchers at SDN Ciracas 03 revealed various concerns from both teachers and students. First, students tend to be passive during the learning process, especially in challenging subjects like mathematics. Second, academic performance in mathematics often falls short of the established minimum competency level (KKM). Third, there is a lack of instructional media or tools to facilitate abstract concept explanations visually. Lastly, students exhibit low literacy culture both at home and in school.

The learning conditions for students in the classroom often seem limited to sitting quietly, listening to the teacher's explanations, and expressing opinions. However, the information received by students may not be well absorbed when using geometry tools in everyday life. Additionally, geometry can be both intriguing and challenging (Afwa, et al., 2021). In the digital era, interactive learning media has become a crucial need for elementary school students who are in the stage of concrete operational cognitive development and may struggle with abstract ideas (Bito & Fredy, 2020; Nurlaily et al., 2019). Teaching abstract concepts through verbal language alone may lead to students understanding material only in terms of words without grasping the underlying meanings. Therefore, instructional media can serve to convey the purpose and objectives of the learning material provided by instructors (Fatimah & Bramastia, 2021).

Based on the identified issues, researchers distributed a questionnaire to assess the needs of students in addressing these challenges. The collected data from the questionnaire indicated that students require learning media for mathematics that incorporate both sound and images, but not necessarily in video format. Consequently, the researchers sought a problem-solving solution by developing an Interactive Digital Comic Learning Media for Plane Geometry based on Ethnopedagogy for lower-grade elementary school students. This digital comic, grounded in ethnopedagogical principles, views local knowledge and wisdom as sources of innovation and skills that can contribute to community well-being (Sri Kasih et al., 2019).

In reality, mathematics is deeply intertwined with culture. It is a social and cultural construct, a pan-human activity (Bishop, 1988). Mathematics exists within culture, is bound by culture, and influences culture (Dominikus, 2019). Etnopedagogy emphasizes the importance of local wisdom values in the educational process and as part of cultural development. Furthermore, in the escalating dynamics of social interactions due to various issues that can trigger conflicts, etnopedagogy serves as a learning model based on differences, aiming to find unity within those difference (Hafid, et al, 2015).

Local wisdom developed in education follows four principles: alignment with student development, competency needs, flexibility in types, forms, and scheduling, and usefulness for national interests in facing global challenges (Muzakir, 2021). Through this

ethnopedagogically-based digital comic on plane geometry, students will learn while also becoming acquainted with cultural elements that need preservation.

Research findings from a study titled "Implementation of Ethnopedagogical Approach Based on Local Wisdom in Thematic Learning for Classroom Teachers" indicate that local wisdom-based education receives positive responses from both teachers and students. This is because students can understand and appreciate the Acehnese local wisdom content embedded in their school learning experience (Fatmi, Faradhillah, & Rezeki, 2023).

Based on preliminary observations conducted through interviews and observations, researchers sought to address existing challenges by utilizing instructional media in the form of a digital comic focused on plane geometry and grounded in ethnopedagogy. The combination of digital comics and ethnopedagogy has not been previously implemented at the elementary education level, making this research innovative. Overall, the study aims to develop an Ethnopedagogically-Based Digital Comic Learning Media for Plane Geometry in lower-grade elementary school classrooms.

The utilization of instructional media should be interactive for students, especially in today's student-centered learning environment. Interactive multimedia is a type of media equipped with controls that users can operate to select their desired next steps (Arini, et al., 2020). Media and educational technology serve to stimulate discussions about digital media, digital technology, and digital culture in education (Potter, 2023). Research findings indicate that perceived usefulness of e-Learning significantly impacts the quality of learning, and perceived ease of use of e-Learning also positively affects learning quality (Baso, Pakawaru, & Nurlailah, 2022).

Interactive multimedia learning media provides direct visualization for students, allowing them to interact directly with the content. Additionally, the media provides feedback, indicating correctness or suitability when students work on practice exercises within the media (Primamukti & Farozin, 2018).

Digital comics combine traditional comic elements with digital technology, opening up new directions for traditional comics. They utilize digital media to enhance both form and content. This includes creating digital comic strip products through methods like apps, official websites, digital TV, or projection technology to showcase the charm of comic books (Wang & Liu, 2021).

Digital comics serve as tools that facilitate access to information and entertainment, including stories presented in comic format. They enhance students' interest in learning, aid comprehension of learning materials, allow anytime, anywhere access, make learning more engaging, creative, and innovative, and ultimately improve the quality of the learning process by fostering high motivation and enthusiasm for learning.

The results of research on the development of Zahlen's Adventure Comics as a Mathematics Learning Media in Flat-Side Space Building Materials state that the Zahlen's Adventure Comics are valid, practical and effective for use (Putro & Setyadi, 2022). Another research entitled Digital Comic Media based on local wisdom, Tri Hita Karanya, shows that digital comic media is very practical and suitable for use by teachers and students in elementary schools (Devi & Werang, 2023).

In the realm of education during the era of globalization, one challenge is developing curricula and learning approaches that align with students' needs and characteristics while

accommodating the cultural diversity present in society. Culture plays a significant role in the teaching and learning process, as it reflects values, norms, and local wisdom held by specific groups or communities. Cultural context also serves as a source of knowledge and experience that helps students understand scientific concepts taught in schools.

It is important to understand, within the context of Ethnopedagogy, that effective and meaningful learning approaches can vary from one culture to another. Therefore, educators need to comprehend their students' cultural backgrounds and consider these cultural differences when developing effective teaching strategies (Hidayat et al., 2023). Ethnopedagogy also explores how educational policies can impact students' cultural and ethnic identities. For instance, if a school curriculum solely focuses on one culture while neglecting others, students from the overlooked cultures may feel undervalued and disregarded.

Ethnopedagogy can be seen as an education method based on local wisdom and rooted in the cultural values and behavioral norms of a specific ethnic group (Abdurrahman et al., 2020). The local culture in the surrounding environment represents potential that can be harnessed and integrated into learning experiences, providing meaningful learning for students (Blackley et al., 2018)**.**

The findings of the research entitled Implementation of a Local Wisdom-Based Ethnopedagogical Approach to Thematic Learning for Class Teachers show that local wisdom-based education provides a positive response from teachers and students, this is because students can know and understand the content of Aceh's local wisdom contained in learning at school (Fatmi, Faradhillah, & Rezeki, 2023).

The topic of plane geometry is essential for teaching in lower-grade elementary schools. It helps students develop spatial thinking abilities, recognize basic shapes, and foster creativity and imagination. However, if not taught appropriately, this material can also lead to difficulties and boredom for students.

Mathematics learning demands that students possess various problem-solving abilities, including mathematical connections. The ability to make mathematical connections is crucial and beneficial to learn because it enables us to understand, apply, and integrate mathematical concepts across various fields of science and real-life situations.

Mathematical connections underpin mathematical thinking. Coxford explains that this ability involves linking conceptual and procedural knowledge, using mathematics in everyday activities, and understanding the relationships between different topics (Siregar & Siagian, 2019). To enhance students' mathematical understanding, it is essential to establish connections between mathematical concepts. Teachers play a vital role in helping students make these mathematical connections (Low & Wong, 2021). Based on theories proposed by various experts, aspects of mathematical connections include using mathematics in daily life, connecting symbols with their representations, linking conceptual knowledge with procedural knowledge, and understanding relationships between different mathematical topics.

Based on the results of preliminary observations carried out by researchers through interviews and observations, researchers need to solve the problems that occur with solutions using learning media in the form of digital comics with ethnopedagogical-based Bangun Datar material. The combination of digital comics with ethnopedagogy, which is still rarely implemented at the basic education level, is a novelty in this research. This research aims to

produce learning media for Bangun Datar Digital Comics based on Ethnopedagogical Learning in lower elementary school classes."

Research Methods

The research and development activities for creating electronic comic learning media on plane geometry were conducted in grades III at SDN Ciracas 03, located at Jl. Raya Centex No.3, RT.5/RW.3, Ciracas, Kec. Ciracas, East Jakarta, Special Capital Region of Jakarta 13740. The research period spanned from January 2024 to May 2024..

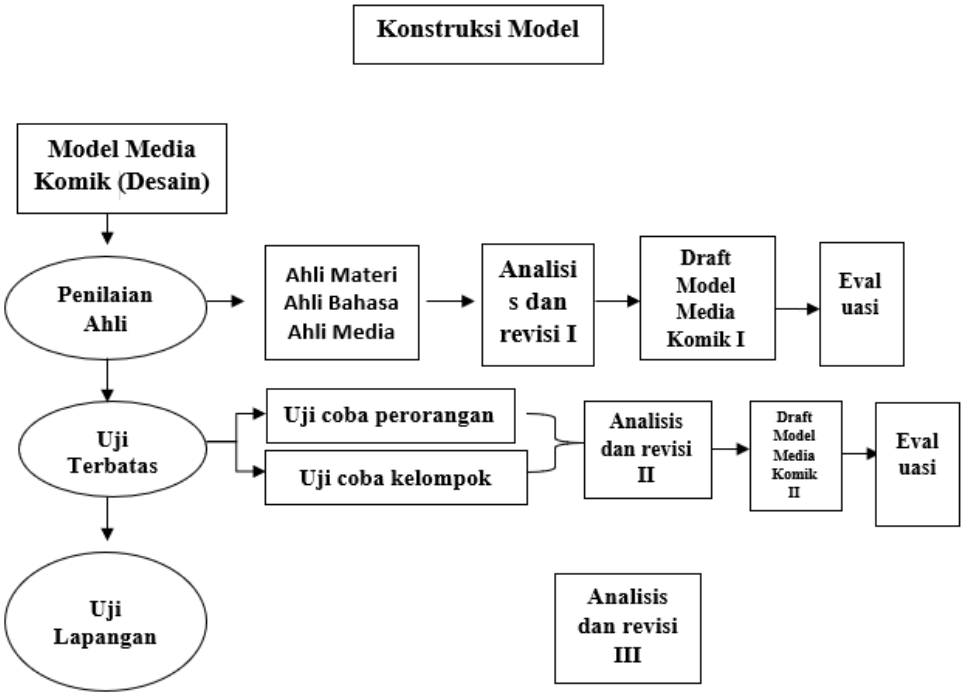
The target audience for this development research was third-grade elementary school students who were studying the topic of plane geometry in their Mathematics curriculum. The research focused on developing interactive digital comic learning media based on Ethnopedagogy for the topic of plane geometry, aiming to enhance students' mathematical connections in lower-grade elementary schools.

The research approach employed was Research and Development (R&D). This method aimed to improve students' mathematical connections by developing digital comic learning media on plane geometry grounded in ethnopedagogical principles.

Among the various models for research and development, this study utilized the ADDIE model, which was developed by Dick and Carey in 1996 for designing instructional systems (Mulyanitiningsih, 2016). The ADDIE model consists of five stages: Analysis, Design, Development or Production, Implementation or Delivery, and Evaluation.

The detailed breakdown of the ADDIE model for this research is as follows: 1) **Analysis**: In this stage, the researcher analyzed the needs and issues within the school through preliminary observations and interviews; 2) **Design**: The design phase involved creating a blueprint for the product, including the user interface. Subsequently, the instructional media was structured according to student needs; 3) Development: The preparations and designs made during the previous stages were realized in tangible form; 4) Implementation: This stage included testing the developed instructional media during actual learning activities, assessing both its appearance and functionality; 5) **Evaluation**: Formative evaluation was conducted during the product development phase, following the chosen model (Safitri & Aziz, 2022).

Researchers conducted research and development of the interactive digital comic Bangun Datar based on ethnopedagogy, in an effort to improve the mathematical connection abilities of lower grade elementary school students. This learning media will be validated by media experts, material experts and language experts. In this development research, we will also test the effectiveness of two-dimentional figure digital comic media based on ethnopedagogical learning to improve the Mathematical Connections of lower grade elementary school students. The product effectiveness test is intended to obtain information about whether the development product is effective or not when applied in the learning process in the field. The product effectiveness test was carried out by looking at the difference in student achievement scores on writing competency before being given treatment and student achievement scores on writing competency after being given treatment. The difference in learning achievement scores is commonly called the difference in pretest scores and posttest scores. The following is the construction of the ADDIE model in this development research:



Picture 1. Construction of the ADDIE Research Development Model

Result and Discussion

The first stage of this research is analysis. At this stage the researcher carried out a needs analysis, curriculum analysis and analysis of the characteristics of 3D class students. Based on the results of interviews with the principal, SDN Ciracas 03 is a school that has kept up with the times. Some teachers at SDN Ciracas 03 use technology in learning. Not all teachers are fluent in using learning media. There are several classes where teachers rarely use conventional or digital learning media. He suggested trying to observe class 3 students as a transition class to higher classes, such as class III C or III D. Apart from that, class 3 students are near the teacher's room so it is often seen that the students are less active and often leave the classroom.

Researchers chose to use 3D class as the subject in this research. Researchers distributed student needs questionnaires to find out what students needed. The following is an analysis of the results of the needs questionnaire for 31 class 3D students.

In the first question regarding the atmosphere when daily learning takes place, 22% of students said learning was quite enjoyable, while the other 78% said it was fun. After that, on the indicator of the importance of the role of learning media in helping to understand learning material in class, 20% of students said it was quite important, while 80% of other students said it was very important.

Obtaining a score of 91% of students stated that 3D class teachers rarely use learning media in the classroom. According to 29% of students, the learning media used by teachers was not good, 51% of students said it was quite good and another 20% of students said it was very good. As many as 93% of class 3D students stated that they needed learning media for mathematics subjects, while 7% of other students needed media for science learning. On the

other hand, 42% of students said they liked learning mathematics using learning media and 58% really liked it.

Regarding the characteristics of learning media that are preferred by 3D class students, 90% of students want to use learning media with the characteristics of having images, sound and being able to be used according to their wishes. Meanwhile, 10% want to learn only by using pictures. This is reinforced by the statement on the student satisfaction indicator when learning using real objects, 10% of students stated that they were not motivated if learning mathematics only using real objects, 51 students were quite motivated and 39% of students were very motivated about this.

In the next indicator related to examples of learning media that students need, namely 16% of students want to use learning media in the form of learning videos, while 84% of students want to use learning media in the form of digital comics.

The learning outcomes that researchers use are that at the end of phase B, students can describe the characteristics of various flat shapes and can arrange (composition) and decompose (decompose) various flat shapes in one or more ways if possible (Kemendikbud, 2022).

Based on observations made by researchers in October 2023, the learning activities taking place in class were quite good. Learning activities that take place in class without new learning innovations make students less active. The teacher's efforts to make students active include encouragement or instructions in the form of commands, so that an active attitude does not grow automatically in students. Based on the results of researchers' observations, students really need innovation in learning, both media and teaching materials that can foster enthusiasm for learning and an active attitude in these students.

Next, the preparation stage, the preparation of the learning media framework refers to the class III syllabus. The learning media that will be developed consists of three parts, including beginning, content and end. The initial part of the learning media contains the cover, foreword, table of contents, instructions for using the media, learning outcomes and learning objectives. The content section of the learning media contains learning material accompanied by practice questions in each comic session, while the closing section contains a bibliography and researcher bionarrative. The following is an example of an image resulting from the preparation of ethnopedagogy-based digital comic media.

Tampilan Sampul Tampilan Isi Tampilan Penutup

Picture 2

Ethnopedagogy-based Flat-Rise Digital Comic Display

The third stage of the ADDIE development model is the development stage. This stage aims to see the feasibility of the learning media that has been designed. This media assessment began with an assessment of the research instrument by the instrument validator and obtained a feasibility score of 94% in the Suitable to use category with revisions according to suggestions. After that, the assessment continues with media, language and material

validators. Then the learning media is revised according to the validator's criticism and suggestions. Validators consist of five expert lecturers and one class teacher.

Based on the assessment of the two media experts, the flat-rise digital comic learning media received a percentage score of 86% out of 100%. Thus, this learning media can be categorized as very suitable for use in lower grade mathematics learning. Based on responses and input from media validation experts, researchers have revised the learning media before group testing. Apart from that, the average score obtained by material experts on this ethnopedagogy-based digital comic media was an average of 96% or could be categorized as very decent. The validation score obtained by linguists for this comic media was 82.5% in the Decent category.

Researchers also tested the validity of the pretest and posttest question instruments with mathematics experts with the question results being in accordance with aspects and indicators of mathematical connections and can be used to test effectiveness in grade 3 elementary schools.

In the individual trial, the researcher distributed questionnaires to two students as an individual assessment of this ethnopedagogy-based digital comic media. Researchers chose class II and III students for one to one trials. Apart from that, researchers also conducted interviews regarding the students' impressions of messages. Based on the results of collecting individual questionnaires, it was found that an average of 90% of students said that the ethnopedagogy-based digital comic media was very good. Small group trials were carried out using 8 (eight) class 3C students with different abilities as research subjects in small groups in this study.

Based on the results of the questionnaire collection, information was obtained that all students enjoyed learning with ethnopedagogy-based digital comic media, and wanted to learn to use comic media again at another time. Apart from that, the comic media provided was very interesting to them and several students asked to share a link to access the comic.

Apart from the positive response to this ethnopedagogy-based digital comic media, there were also suggestions or input from the students, including: There are still small letters so they need to be revised, there is an accompanying piece of music which seems to need to be changed so that students are more solemn when listening, and practice questions need to be added to make learning fun.

Researchers applied this learning media in the classroom after the ethnopedagogy-based digital comic media was declared feasible by all validators. This implementation was attended by 31 students and held 4 times in class meetings for 6 hours (6 x 45 minutes). The following are the results of data analysis in large group trials:

Tabel 1
Hasil Perolehan Data

Jenis Tes	Skor	Kesimpulan
Uji Normalitas	Pretest 0,518 Posttest 0,162	**Normal**
Uji Homogenitas	0,113	**Homogen**
Uji-t Paired samples Test	0,000	**Ada Pengaruh positif**
Uji N-Gain	0.7061	**Tinggi**

In the large group trial, several data were obtained regarding the effectiveness of using ethnopedagogy-based digital comic media, including: 1) The pretest score obtained a sig value of 0.518 and the posttest obtained a significant value of 0.162 > α 0.05. It can be concluded that the pretest and posttest data were normally distributed. , so that the Homogeneity test can be continued; 2) The homogeneity test results show that the significance value obtained is 0.113. The Sig value is 0.113 > 0.005, so the pretest and posttest data can be said to be homogeneous, and the T test can be continued; 3) The results of the paired samples t-test analysis show that the calculated t value is 0.05 with a significance of 0.000 < 0.05 so that $H0$ is rejected and $H1$ is accepted. It can be concluded that there is the influence of ethnopedagogy-based digital comic media with mathematical connections. Based on the results of research that has been carried out on improving the mathematical connections of 3D class students using pretest and posttest with the analysis method of normality test, homogeneity test and t test, all of these assumptions are fulfilled and there is an influence of the use of ethnopedagogy-based digital comic media on increasing mathematical connection abilities 3D class students; and 4) The results of calculating the N-Gain value obtained an average N-Gain score of 0.7061. In this case, based on the N-Gain score, the score is 0.7061 > 0.7 or can be categorized as high. In this case, the increase in students' mathematical connection abilities is relatively high.

Conclusion

The researcher carried out the development of digital comic media based on Ethnopedagogy, following the ADDIE research flow with 5 (five) stages including: 1) Analysis, 2) Design, 3) Development or Production (Development), 4) Implementation or Delivery (Implementation), and 5) Evaluation (Evaluation).

The feasibility of this ethnopedagogy-based flat-rise comic media received an average score from media experts of 86% and material experts of 96%, for this score was categorized as "Very Appropriate". Apart from that, the average for linguists is 82.5% in the "Decent" category. In this case, the overall score obtained by the experts was that the ethnopedagogy-based digital comic media obtained an average score of 88.16% with the "Very Appropriate" category used for lower grade elementary school students.

Based on the results of the effectiveness test for the development of flat building learning media based on ethnopedagogy, the results of the Paired Sample T Test show that the calculated t value is 0.05 with a significance of 0.000 < 0.05 so that $H0$ is rejected and $H1$ is accepted. It can be concluded that there is a positive influence of ethnopedagogy-based digital comic media with mathematical connections. Based on the results of calculating the N-Gain value, it was found that in this study the average N-Gain score was 0.7061. In this case, based on the N-Gain score, the score is 0.7061 > 0.7 or can be categorized as increasing students' mathematical connection abilities as "High".

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