THE DEVELOPMENT OF E-COMIC FOR SOCIAL ARITHMETIC LESSON AT THE ELEMENTARY SCHOOL LEVEL USING THE ETHNOMATHEMATICS APPROACH OF MAKASSAR CULTURAL PRODUCTS

Azizah Mujahidah Annisa[1*], Gunawan Wiradharma[2], Mario Aditya Prasetyo[3]

[1, 2]*Universitas Terbuka (INDONESIA)*
[3]*Universitas Indonesia (INDONESIA)*

[*]azizah.annisa@ecampus.ut.ac.id

Abstract

Mathematics learning activities guided by teachers still need to meet expectations. Educators still need to implement various innovations in learning media and focus on only one source: textbooks. As a result, students experience difficulties understanding the material because object interpretation differs from reality. Educators have also begun to appreciate the use of cartoons or comics in class, which have become popular media among students. This is because reading comics or picture books that are visually appealing can attract students' attention, thereby fostering a sense of imagination in their thinking. In addition, mathematics education can be interpreted as a method to inspire students to master mathematics by connecting the mathematics material taught with local culture or existing cultural practices. This study focuses on community activities in Makassar, South Sulawesi Province, and the cultural product taken is Jalangkote. This study uses a Makassar cultural ethnomathematics approach to create an e-comic design for elementary school social arithmetic material. The ADDIE model is a development model used in e-comic Design, and the research method used is Research and Development (R&D). The ADDIE model comprises five phases: analysis, Design, development, implementation, and evaluation. The five stages are summarized into three components: planning, development, and evaluation. The initial component of this study relates to planning. Needs analysis and Design consist of the planning phase. The needs analysis stage involves gathering information to identify potential problems associated with developing electronic comic learning media. This is achieved through surveys and interviews with mathematics subject instructors. The design stage involves e-comic product planning and integrates Ethnomathematics into the storyline framework. Electronic/digital comics (e-comics) are one form of learning media that can be incorporated into everyday life and used to communicate scientific messages visually appealing or distinctively.

Keywords: e-comic, social arithmetic, learning media, ethnomathematics.

1 INTRODUCTION

Innovation in education is essential to foster student creativity. In the field, mathematics learning activities carried out by instructors are different from the expected results (Aprilla, 2020). Teachers still need to implement significant innovations in learning media and still depend on one source: textbooks. As a result, students have difficulty understanding the material because their understanding of the object is incomplete (Januarisman & Ghufron, 2016; Nurhasanah et al., 2016). The utilization of learning media in elementary schools is a critical aspect that needs the attention of educators because students at this level have limitations in understanding abstract concepts (Musafanah, 2017). Understanding the variety and characteristics of learning media is very important so that it can be used appropriately (Rohmanurmeta, 2019). Using appropriate learning media can achieve successful learning (Putri, 2017). Conversely, educators must evaluate the selected learning media's attractiveness (Lailiyah, 2020). Learning media must be selected according to student needs.

Students' cognitive abilities and structured communication skills will be enhanced through active learning. Educators also consider the use of cartoons or comics in the classroom, as they have the potential to increase understanding and interest, increase motivation to learn, improve behavior, and increase productivity and creativity. Furthermore, it has the potential to relieve tension and anxiety, increase student engagement in the learning process, and reduce boredom during learning and teaching activities (Aiman, 2020).

Students are fond of comics because they attract their attention through exciting illustrations, fostering a solid imagination (Siregar, 2019). Comics are an exciting learning medium that consists of images. Students are more involved in reading and acquiring abstract mathematical concepts when they use comics as a learning medium (Pardimin & Widodo, 2017). Comics are also permanent reading materials encouraging readers to foster curiosity (Ntobuo et al., 2018). Comics can now be accessed in electronic format along with technological advances. Electronic comics, or *e-comics*, are digital comics used to communicate scientific messages in a visually appealing and unique way (Rivai, 2021). One way to utilize learning media is to package it as a comic (Apriliani & Radia, 2020). Research by Indriasih et al. (2020) revealed that children can be encouraged to learn through *e-comic* learning media. According to Indarsih, e-comic learning media is suitable for improving the life skills of elementary school students. The application of e-comics can also facilitate access to learning materials for students in distance learning. According to the research of Adeliyanti et al. (2018), the creation of

technology-based math *e-comics* and functioning as a learning supplement for quadratic function applications developed using the 4D development model is considered a practical, effective, and valid medium for teaching mathematics.

Although technology is now more advanced, our culture must be nurtured so contextual learning can work well. The learning process can be influenced by math and culture. Indirectly, people have applied math in their daily lives. Math is one of the components of culture. Ethnomathematics is a term used to describe the application of mathematics in everyday life in a society. According to D'Ambrosio (in Dominikus, 2018), Ethnomathematics is the application of mathematics in specific cultural groups, such as ethnic groups, labor groups, professional classes, and children of a certain age. In Ethnomathematics, the culture of a society contains mathematical concepts (Sroyer, 2018). D'Ambrosio argues that Ethnomathematics in mathematics education can be defined as a method to encourage students to acquire mathematics by linking mathematical material with local culture or pre-existing cultural practices.

Social arithmetic is a math subject that examines basic number operations relevant to everyday life. If presented with educational media, this material is quite interesting for students and teachers (Friantini et al., 2020). Learning social arithmetic provides its own experience for elementary school students related to financial literacy. The science of arithmetic, social arithmetic, examines the basics of addition, subtraction, multiplication, and division and the properties of numbers (Harahap, 2010). Thus, students can implement it in their daily lives.

This study focuses on community activities in Makassar, South Sulawesi Province. The Ethnomathematics taken is Jalangkote. Jalangkote is a traditional food from the Makassar tribe in South Sulawesi. It looks like a pastel cake and is usually eaten with *samla*, a mixture of chili and vinegar. Jalangkote is a prevalent Makassarese food known since the 19th century, and it is found very easily in various places in Makassar City because of its popularity. This traditional snack is also usually sought after as a souvenir. Residents often make it a breakfast menu and a dish at various events and celebrations, not only as a snack.

Several researchers have conducted several related studies. Zaenuri and Dwidayati (2018) have started an ethnomathematics analysis and obtained the result that the concept of social arithmetic can be found as a cultural product from Semarang City. Wulandari (2020) conducted an ethnomathematics analysis on Jambi's specialties to obtain learning instruments for social

arithmetic material. The same findings were presented by Pramesti and Rasmanto (2021), who mentioned that the mathematical concept that can be integrated into the activities of the coastal community of Wonokerto, Pekalongan Regency, is social arithmetic. These findings show that social arithmetic can be found in several buying and selling activities, so further research is needed. Fitriza's research (2018) intends to reveal the mathematical concepts in the ornaments found in *Rumah Gadang* and the development of these ornaments. The study findings show that the ornament design in Rumah Gadang has the characteristics of symmetry and similarity. Rahmawati's research (2020) intends to determine junior high school student's understanding of using the Pythagorean Theorem in *Rumah Gadang*. The results showed that Minangkabau traditional houses were built using mathematical elements and concepts, especially the Pythagorean Theorem.

The formulation of the problem in this study is how to design an *e-comic* on learning social arithmetic at the elementary level with an ethnomathematics approach. This research is expected to contribute to developing interactive and fun learning media in the form of *e-comics* to facilitate a meaningful educational process for students. The ethnopedagogical approach is also used in the Design of this *e-comic*, which can increase the contextualization of learning. Based on previous studies, this designed media is the latest step in using comics with an ethnomathematics approach to Makassar cultural products, especially Jalangkote.

This research proposes an *e-comic* learning media design for elementary school social arithmetic education using an ethnomathematics approach as an open learning resource. The novelty of this research is the development of feasible and enjoyable learning media, with an ethnomathematics approach to Makassar culture with a focus on elementary school social arithmetic learning. Students' interest influences their choice of e-comic when reading comics or books with exciting illustrations that stimulate their creative thinking. Learning is also based on Ethnomathematics to foster character values. Love for one's own culture is the character value being discussed. Students can engage with the culture that is the subject of Ethnomathematics through learning mathematics associated with cultural elements that can provide new experiences.

2 METHODOLOGY

Research and Development (R&D) is a methodology used to develop e-comics. Sugiyono (2017) states that research and development is a methodology used to produce products and

evaluate their efficacy. The ADDIE model, one of the systematic learning design models, is the development paradigm for this development. This paradigm was chosen due to its systematic development and theoretical foundation in learning design. The model is structured in a way that is consistent with the requirements and characteristics of learners and is organized in a systematic sequence of activities to address learning challenges related to learning resources. This paradigm consists of five stages: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. The five stages are divided into planning, development, and evaluation. The initial component of this investigation relates to the planning process. The planning part includes two stages: *analyzing* in *the* form of a *need assessment* and *designing*. The duration of this investigation is two years. In 2024, the first year will be dedicated to planning and development. The evaluation phase will be conducted in the following year. Subsequent investigations will include development, implementation, and evaluation stages.

The needs analysis stage entails gathering information to identify problems related to learning media development. This process includes interviews with math teachers to understand learners' needs in learning social arithmetic. This analysis also includes an assessment of material needs, learning objectives, and student needs and an analysis of Makassar culture related to the subject matter. Furthermore, the analysis stage involves gathering information to identify potential problems in developing e-comic learning media. Data and information collection were conducted through field observations, surveys, and interviews with mathematics subject teachers to find out the continuous learning needs of elementary school students, deliver social arithmetic materials, and gather information about their preferences and needs for social arithmetic content and relevant cultural aspects (Ethnomathematics) of Makassar. An analysis phase was conducted during this phase, including examining students' needs, learning objectives, and materials.

The next stage is Design. The design stage is an advanced phase of the analysis stage. The design stage will plan an *e-comic* product and integrate Ethnomathematics within the storyline framework. At this stage, a contextual flow is made related to integrating Makassar Ethnomathematics with social arithmetic material. To start developing *e-comic* learning media, it is necessary first to ascertain the discussion material used. At the design stage, researchers will prepare reference books, search or collect materials related to concepts and materials about elementary school social arithmetic, and compile exercise questions that will be included in the *e-comic* learning media. In addition, it is necessary to prepare the learning flow and

implementation plan of *e-comic* learning media about elementary school social arithmetic to be developed.

Data collection has been conducted based on the results of the needs analysis of teachers and students through the distribution of questionnaires and needs analysis from experts based on interviews. The next stage, which involves planning, was informed by the data acquisition results in a needs analysis. Furthermore, a literature review was conducted during this initial stage. The aim was to identify theoretical concepts that would facilitate the identification of appropriate phases of product development (Sukmadinata, 2006).

3 FINDINGS AND DISCUSSION

This research results in e-comic learning media that can be accessed using a *smartphone* named "Ethnomathematics *E-Comic*: Sahabat Jalangkote." The e-comic was made with an ethnomathematics approach to Makassar culture, namely Jalangkote. In the e-comic, a storyline raises several mathematical problems related to social arithmetic material at the elementary school level. The following section describes the research process during the first year, emphasizing the planning phase.

3.1 Student Needs Analysis

The student needs analysis stage was carried out on 35 PGSD FKIP UT Study Program students who filled out the questionnaire. The data collection stage was carried out on July 1-15, 2024, at the Universitas Terbuka, Makassar. All respondents understood social arithmetic well and could teach it effectively. Reported teaching methods included discussion (50%), lecture (50%), presentation (50%), and practice problems (100%). These diverse methods reflect the teachers' efforts to tailor teaching to students' different needs and learning styles.

Despite this high level of understanding, there needs to be more between understanding the material and effective teaching practices, as reflected in the difficulties encountered in teaching the material. This shows that theoretical understanding only sometimes goes hand in hand with the ability to communicate these concepts to students effectively. This is shown through the results of the questionnaire, where 70% of teachers use discussions, 30% use lectures, 50% use presentations, and 80% use practice problems. In reviewing the teaching approaches used, teachers generally place a strong emphasis on practice problems to deepen students' understanding. One factor that hinders students' ability to understand spatial geometry material is the number of exercises and monotonous discussions they consider less attractive.

Most teachers already use technology in teaching with tools such as whiteboards and markers, which all respondents use, and PowerPoint or ICT by 60%. However, 20% of teachers have not integrated technology into their teaching. Although most teachers already use some form of technology, such as ICT and PowerPoint, responses show these technologies have not been fully effective in overcoming the problem of students' aversion to the material. This suggests that it is essential to use technology and integrate it into teaching strategies. In using technology, it is also necessary to highlight the diversification of learning media to increase student engagement.

In the questionnaire results, all teachers experienced obstacles with the main issues, including difficulty applying concepts at 30%, students' difficulty calculating multiplication by large numbers at 30%, and a lack of exciting learning media at 40%. These difficulties highlight the importance of developing more engaging and supportive learning resources that can help overcome these barriers and enrich students' learning experiences. Introducing more engaging and innovative learning methods, such as *e-comics,* could provide a more immersive and engaging learning experience. The process of learning mathematics involves the reconstruction of concepts and principles; it is not limited to static and static learning; instead, it is a dynamic and active process (Rusnandi et al., 2016).

This shows that creative efforts are needed to adopt more interactive and exciting methods to improve student understanding. Turmudi (2008) argues that students have yet to be actively involved in learning mathematics. Furthermore, mathematics teaching is delivered in an informative way, resulting in low "engagement" among students, who receive all information from the teacher. As the subject of learning, students are less involved in identifying the concepts of the lesson that they must understand. This results in the concepts taught to students not being firmly embedded in their memories. It causes them to forget quickly and often get confused when faced with problems different from those exemplified by their teachers. Therefore, educators must develop and distribute teaching materials that encourage students to engage actively and dynamically in acquiring and understanding mathematical concepts.

Most students find math boring (Nuraini & Edy, 2017). This results in more abstract math material, which results in a more abstract learning experience. Educators need to be able to facilitate engaging, innovative, and inventive math learning activities. Learning media is one of the factors that can increase the enjoyment and interest of mathematics education. *E-comic*

media is one of the options in the learning process. Innovative learning media provides a more exciting and efficient learning experience that increases the effectiveness of the learning process (Huang et al., 2016).

Respondents' answers were also very supportive of using *e-comics,* with 90% of teachers agreeing that e-comics on social arithmetic could be used as a learning medium. These teachers were simultaneously interested in using *e-comic* in the learning process, signaling their readiness to integrate this innovative approach into their teaching. In the contemporary era, the use of technological media in the learning process dramatically impacts the learning process (Sakat et al., 2012). As a result, advanced technology can be used to create more innovative and inventive learning media. Teachers also agreed that features such as learning videos and practice questions in educational games would be helpful.

In addition, integrating social arithmetic material in *e-comics* with an ethnomathematics approach - using elements of local culture - was seen as an innovative way to make the material more relevant and exciting for students. Respondents strongly supported integrating Ethnomathematics in the e-comic through the questionnaire results, with all teachers agreeing that this approach could facilitate understanding of the material and increase students' interest in learning. In addition, all respondents agreed that social arithmetic materials should be linked to local culture or traditions through media, such as e-comics. This has proven that Ethnomathematics examines the culture of the surrounding community to bring mathematics to life in learning (Setiana et al., 2021). This makes it easier for students to understand mathematical concepts to improve their math learning outcomes.

This analysis shows teachers' strong support for using ethnopedagogy and technology in teaching social arithmetic. Creating *e-comics* focusing on aspects of local culture and economy could be an effective way to facilitate more in-depth and enjoyable learning of social arithmetic. In addition, integrating local culture through e-comics and diverse teaching approaches shows the potential to improve students' understanding and engagement.

3.2 Expert Needs Analysis

Based on interviews with experts, learning social arithmetic is considered quite tricky because it depends on numeracy and language comprehension factors.

"Currently, teaching Arithmetic at the elementary school level often still uses conventional methods, with some illustrations that are not sufficient to facilitate understanding. This calls for a more concrete method. Good numeracy skills and problem understanding are necessary to understand arithmetic material effectively. Moreover, social arithmetic taught in elementary school is closely related to mathematics used in everyday life, which is important to learn because it has many uses, including facilitating transactions in various economic activities."

This statement is consistent with research that shows students' challenges in social arithmetic are a result of their lack of language skills, which include the inability to understand or interpret questions and retell them in language. Then, there are also student challenges in the prerequisite aspect, particularly in the language aspect, which results in students failing to record what is known and required, failing to understand the concept, and failing to determine the formula. Lastly, students need help with applied aspects, specifically in the calculation process, which prevents them from concluding their responses to questions (Dila & Zanthy, 2020). Therefore, using effective learning media to understand social arithmetic material is essential. Incorporating engaging learning media into the educational process can inspire students to develop new interests and desires, increase their motivation to learn, and even introduce psychological influences (Azhar, 2017).

According to the expert's explanation, the things needed to learn social arithmetic material are the ability to read and calculate operations in dealing with the questions given.

"There are several skills needed in learning arithmetic material, namely literacy and numeracy skills, analytical skills (critical thinking), problem solving skills."

Numeracy literacy is essential for students because it can help them understand social arithmetic material. Numeracy literacy is a valuable skill that is essential for students to excel in various fields and compete on a global scale. Numeracy literacy applies to *Science, Technology, Engineering, and Mathematics* (STEM). *The Program for International Student Assessment* (PISA) is one of the international standards that can be used to assess or measure numeracy literacy (Lane et al., 2019). The latest results for 2023 were released by the *Organization for Economic Cooperation and Development* (OECD), the institution that organizes the PISA program. Indonesia did improve its math and numeracy literacy by five places; however, the score decreased by 13 points compared to the 2018 score. Indonesia's math score was 366, 106 points lower than the global average. Math literacy and numeracy are

the areas with the most limited proficiencies below level two. The percentage is *82%* (OECD, 2022). This indicates that there is still a significant need for development in numeracy literacy and mathematics education, as these are essential skills required by all individuals in the contemporary era. Numeracy literacy enables individuals to acquire, describe, analyze, use, and communicate mathematical symbols. These mathematical symbols can be used to solve problems, make determinations, and make decisions (Perdana & Suswandari, 2021; Rakhmawati & Mustadi, 2022; Sari et al., 2021).

The learning process was evaluated against the completed spatial structure material in several ways. For example, expert statements:

"The main evaluation is that most learning processes are still guided by printed books and lecture methods...Learning is also not creative because it does not utilize media or technological developments."

The material in printed books is considered less relevant because concrete examples are needed to understand social arithmetic material, which cannot be obtained only through text and images. Using *e-comic* as a creative tool to assist educators in delivering material with conventional comic visualization is expected to increase its attractiveness and facilitate understanding (Abdillah et al., 2020). This problem can be solved by utilizing e-comics as a learning medium that increases students' interest in learning and exploring abstract mathematical concepts (Pardimin & Widodo, 2017). Research by Indriasih et al. (2020) revealed that using *e-comic* learning media can arouse children's enthusiasm for learning. Indarsih also emphasized that *e-comic* learning media is appropriate for improving the life skills of elementary school children.

From the interview process, the informant (expert) gave an opinion about learning interesting social arithmetic material, namely the exploration process through concrete things to reduce learning boredom.

"Using media in accordance with technological developments."

"Interesting social arithmetic learning is by applying directly in real life reinforced with interesting props."

"Making learning interesting and meaningful for students can be done with something that is close and remembered by them, namely by utilizing gadgets and students are interested in

reading material about social arithmetic because the age in this technological era is very supportive of it."

"Arithmetic learning will be more interesting if done by utilizing interesting media that can provide illustrations to students so that learning looks more concrete."

"Learning interesting social arithmetic material should use learning media that is in accordance with the characteristics of elementary school children."

"Constructivist, reality-based learning (problem solving)."

The constructivist perspective is consistent with the concept of meaningful learning in mathematics education, as students are said to understand if they generate meaning from their experiences by establishing cognitive connections between new experiences and prior mathematical knowledge rather than simply memorizing formulas or propositions (Gazali 2016). Z.P. Dienes (in Bossé et al.) revealed that students can only fully understand a mathematical concept or principle if it is initially presented to them in a concrete form that allows them to understand the importance of manipulating objects in mathematics learning.

In addition, expert informants argue that further consideration is needed to use the ethnomathematics approach in designing materials on the learning media made.

"This is very good because through the Ethnomathematics approach it can teach local wisdom to students. Besides, it can also give appreciation to citizens in the area by promoting culture."

"Learning with ethnomatics using cultural products is also very important, but of course you have to pay attention to the suitability of the material with these cultural products. For social arithmetic material, there are several subs that can be related to cultural products and this can make learning more concrete."

This is in line with the statement that Ethnomathematics plays an essential role in the integration of technological progress and the preservation of local wisdom through the application of science (Nur et al., 2020; Nuryadi et al., 2020; Permata et al., 2021). According to Putra and Mahmudah (2021), ethnomathematics-based learning is essential in advancing science, especially for students. Using Ethnomathematics in mathematics learning will facilitate abstraction, idealization, and generalization of mathematical concepts (Widada et al., 2018). Ethnomathematics is the right choice for mathematics teachers because it integrates

local culture to ensure that mathematics can be applied in a cultural context (Ilyyana & Rochmad, 2018; Irawan et al., 2018; Manoy & Purbaningrum, 2021).

The features needed to learn e-comics material in *mobile learning* are good learning features.

"Comics must be colorful, have characters. In addition, the e-comic needs to be equipped with other media so that the e-comic is not just a comic, but a learning comic that can be used as a learning medium."

Students are very fond of comics because they attract their attention through the use of interesting illustrations, which in turn fosters a strong imagination (Siregar, 2019). Comics are also timeless reading materials that encourage readers to foster curiosity (Ntobuo et al., 2018). Thanks to technological advances, comics can now be accessed in electronic format. E-comics are used to communicate scientific messages in a visually appealing and unique way (Rivai, 2021).

After conducting the data collection stage through needs analysis from teachers and experts, the next stage is planning. The planning stage shows that e-comic media is needed for social arithmetic material to facilitate learning, improve students' math skills, and explore abstract concepts interestingly.

3.3 E-Comic Media Creation Planning

The e-comic media to be developed includes e-comics used in learning social arithmetic at the elementary school level using the Makassar cultural ethnomathematics approach. Students are allowed to choose the place and time that suits their level of learning preparation. The e-comic media offers alternative times and locations for students to learn without external pressure, which aligns with the principle of enjoyable learning. This is the advantage of digital media in terms of time and location because it allows students to access materials and information anytime and anywhere (Ally, 2009). This is because *e-comic* is a learning media that utilizes technology so that students can access information and learning materials easily wherever they are.

Utilizing the concept of *e-comic* animation to present mathematics is one approach to broaden students' horizons and accelerate the learning process. An e-comic capsule contains an entire series of stories and images. Due to their engaging educational capabilities, e-comics can increase the attractiveness of learning for students and positively impact their academic

performance. Material is more accessible for students to understand when presented in text and images designed to arouse their interest in reading. Thus, there is a need for learning media that significantly facilitates the learning process, such as e-comic learning media. The *e-comic* created explores the concept of social arithmetic by discussing various mathematical problems adapted to the narrative. The narrative produced by *e-comics* is more straightforward for students to remember and understand (Meilani et al., 2022).

4 CONCLUSION

The study findings show that using e-comic as a learning medium has great potential to increase motivation and understanding of mathematics among students by presenting materials that are not only educational but also interesting and contextual to local culture. This research enhances fun and interactive learning media design references, offering a new perspective on integrating technology and culture in mathematics education. The use of e-comic is expected to support a more in-depth and multicultural learning process by utilizing local wisdom in presenting subject matter to make the material more relevant and exciting for students.

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