DEVELOPMENT OF MATHEMATICAL DIGITAL COMICS WITH ETHNOMATEMATICS APPROACH FOR GRADE III ELEMENTARY SCHOOL ON THE MATERIAL OF WEIGHT UNIT CONVERSION

Sabilla Putri Arliani
Pendidikan Matematika, FMIPA, Universitas Negeri Surabaya,
email: sabilla.18077@mhs.unesa.ac.id

Siti Khabibah
Pendidikan Matematika, FMIPA, Universitas Negeri Surabaya,
email: sitikhabibah@unesa.ac.id

Abstrak

Perkembangan teknologi telah mempengaruhi sebagian besar aspek kehidupan manusia, tidak terkecuali dalam aspek pendidikan. Peran teknologi dalam pendidikan dapat ditemukan dalam perkembangan media pembelajaran. Salah satu kesulitan yang dihadapi siswa yaitu menghubungkan matematika yang didapat di sekolah dengan kehidupan nyata. Komik digital dengan pendekatan etnomatematika dapat menjadi salah satu media pembelajaran yang potensial untuk menghubungkan matematika sekolah dengan dunia nyata. Tujuan dari penelitian ini yaitu untuk mengembangkan dan menghasilkan komik digital matematika dengan pendekatan etnomatematika yang layak untuk materi konversi satuan berat dari g ke kg dan sebaliknya untuk kelas III SD. Metode yang digunakan adalah ADDIE. Kriteria penilaian komik digital yang digunakan adalah valid, praktis, dan efektif. Pemilihan subjek penelitian dilakukan menggunakan teknik _purposive sampling_ dan didapatkan subjek 20 orang siswa kelas III SD dan dua orang validator ahli media sekaligus ahil materi. Hasil penelitian menunjukkan bahwa komik digital yang dikembangkan memenuhi kriteria valid dengan tingkat validitas sebesar 80,35%, praktis dengan presentase kepraktisan sebesar 81,87%, dan efektif karena 100% siswa memenuhi KKM. Sehingga dapat disimpulkan bahwa komik digital yang dikembangkan layak digunakan dalam kegiatan pembelajaran matematika karena memenuhi kriteria kevalidan, kepraktisan, dan keefektifan dan diharapkan dapat digunakan pendidik sebagai media pembelajaran untuk menambah semangat serta meningkatkan hasil belajar siswa.

Kata Kunci: media pembelajaran, komik digital, pendekatan etnomatematika.

Abstract

Technological developments have affected most aspects of human life, including education. The role of technology in education can be found in the development of learning media. One of the difficulties faced by students is connecting the mathematics they get in school with real life. Digital comics with an ethnomathematical approach can be one of the potential learning media to connect school mathematics with the real world. The purpose of this research is to develop and produce a mathematical digital comic with an ethnomathematical approach for converting weight units from g to kg and vice versa for grade III SD which is suitable for use. The method used is ADDIE. The criteria for evaluating digital comics used are valid, practical, and effective. The selection of research subjects was carried out using a purposive sampling technique and the subjects obtained were 20 third grade elementary school students and two media expert validators as well as material experts. The results showed that the digital comics developed met the valid criteria with a validity level of 80.35%, practical with a practicality percentage of 81.87%, and effective because 100% of students passed the KKM. So it can be concluded that the digital comics developed are suitable for use in mathematics learning activities because they meet the criteria of validity, practicality, and effectiveness and are expected to be used by educators as learning media to increase enthusiasm and improve student learning outcomes.

Keywords: learning media, digital comics, ethnomathematical approach.

INTRODUCTION

Technology continues to evolve with the times. This development is characterized by many technological innovations in every aspect of human life. Most technological innovations facilitate human life. One aspect of human life that is affected by technology is education. Education is one of the important foundations for a country, including Indonesia. The importance of education is also stated in the Opening of the 1945 Constitution, which states that education is the right of all nations. In order not to

experience lag with other countries, education must be able to keep up with the times, one of which is the application of technology in the field of education. The entry of technology into the world of education can be seen in the means and infrastructure of learning in schools. Equipment such as computers, LCDs, projectors, and laptops are now available in schools. This equipment acts as a learning medium that helps teachers in teaching and learning activities.

Learning media consists of two words, namely media and learning. Gagne & Briggs (in Arsyad, 2019) states that media is a variety of intermediary forms that a person uses to give opinions or ideas so that others can accept them. In other words, learning media includes tools that are physically used to deliver learning materials. Examples of learning media include books, videos, movies, and slides. Arsyad (2019) explained that learning media is a medium that conveys instructional information or has a purpose in teaching. Hamalik (in Arsyad, 2019) states that using learning media in the teaching and learning process can cause new desires and interests, arouse motivation and stimulation of learning activities, and even influence students psychologically. The statement aligns with Wicaksono (2016), who states that media can help teachers deliver learning materials more quickly and easily accepted by students.

Comics can be one of the potential learning media. According to KBBI, comics are illustrated stories that are generally easy to digest and can be found in magazines, newspapers or the form of books. Saraceni (2003) suggests that comics contain components, namely panels, word balloons, descriptions, characters, and backgrounds. Print and digital comics are two types of comics known to the public. The main difference between printed comics and digital comics lies in the format used by both. Digital comics can be read using certain electronic devices. Some advantages that digital comics have overprint comics include that comics can last a long time, be interactive, more dynamic, and more accessible (McCloud, 2008). Comics contain illustrations with a variety of attractive colours. Ilistrasi used in learning can attract students' interest in learning (Mawanto et al., 2020).

According to Ascher (1991) in Arwanto (2017), ethnomathematics studies mathematical ideas in traditional societies. Ethnomathematics was introduced by D'Ambrosio, a Brazilian mathematician, in 1977. Ethnomathematics can be interpreted in mathematics applied by a recognizable cultural group, such as tribal societies, labour groups, people of a certain age, and the professional class (Arwanto, 2017).

Integrating mathematics learning with culture is based on students' difficulties connecting mathematics obtained in school with real life. Hiebert & Capenter (1992) states that mathematics learned in school differs from mathematics in everyday life. One approach that can be used to connect mathematics inside and outside the school is the ethnomathematics approach (Adiansha et al., 2021). The ethnomathematics approach is a culturally-based mathematical learning approach that grows and develops in local communities. Ethnomathematics content in learning can enrich the knowledge gained by students (Tandililing, 2013). In its application, various cultural manifestations can be a context of examples of a mathematical concept or principle and the application of a concept or principle (Suryadinata et al., 2018). It can be concluded that digital comics with an ethnomathematics approach are a medium of mathematical learning in the form of electronic comics that use culture as a storyline.

Nisa' (2019) research shows that digital comics that use ethnomathematics approaches can help students learn mathematics while getting to know Indonesian culture in one application. The research is in line with research conducted by Ayuningsih (2020) under the title "Development of E-Comic as a Learning Media with Ethnomatematic Approach for Junior High School Students," with the results of digital comic research that is worth using. The difference between the research and the research conducted lies in the material and the level of education. In the regulation of the Minister of Education and Culture RI No. 37 of 2018, there are essential competencies (skills) "Describing and determining the relationship between raw units for length, weight, and time that are commonly used in everyday life" with one of the essential materials, namely "conversion of raw weight". This research aims to develop and produce a learning medium in mathematical digital comic applications using ethnomathematics approaches that meet valid, practical, and effective criteria on the material of conversion of kg to g and vice versa in grade III elementary elementary elementary school.

METHOD

The method used is development research with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The identification of curriculum, materials, and technologies is carried out at the Analysis stage. Scripting, character design, and comic frameworks are done at the Design stage. Digital comics began to be developed and continued with the validation stage by validators at the Development stage. Digital comics were later revised according to the validator's criticisms and suggestions. In the Implementation stage, digital comics are used in real situations and the spread of questionnaires as a test of practicality and effectiveness. The last stage is Evaluate. At this stage, an evaluation of the data that has been obtained at the previous stage is carried out. The study

subjects were selected using purposive sampling techniques, namely selecting samples with certain criteria (Sugiyono, 2009) and obtaining two experts as validators and 20 elementary school grade III students with appropriate criteria.

The media criteria set out in this study are valid, practical, and effective with the following information.

1. **Valid**

A validity test is performed to determine the degree of validity of the content of the developed digital comics. Two experts in mathematics and ethnomathematics learning media and material experts carried out the test using questionnaires. The data obtained is then processed with the following formula.

Validity (V) $= \frac{\sum x}{M} \times 100\%$ … (1)

With the description, x is the value of the validation questionnaire of each category obtained from the validator, $\sum x$ is the total value of the questionnaire, and M is the total maximum value of the validation questionnaire.

The validity assessment questionnaire used uses the Likert scale. The Likert scale determines a person's opinion of an object, ranging from negative to positive (Widoyoko, 2017: 115). The Likert scale used is a scale with four numbers.

Table 1. Validity Test Questionnaire Likert Scale

Score	Description
4	Very good
3	Good
2	Poor
1	Very poor

The data obtained are then categorized based on the criteria adapted from Lestari & Ekawati (2019).

Table 2. Validity Test Criteria

Validity Value	Category
$86\% < V \leq 100\%$	Very valid, no revision required
$70\% < V \leq 86\%$	Valid, needs a little revision
$56\% < V \leq 70\%$	Less valid, requires major revisions
$0\% < V \leq 56\%$	Invalid, unusable

2. **Practical**

The digital comic practicality test aims to determine the ease of use of comics and students' interest in digital comics (Lestari and Ekawati, 2019).

The practicality test is carried out by spreading the response questionnaire to students. The formula for determining the value (%) of practicality is as follows.

Practicality (P) $= \frac{Re}{Rh} \times 100\%$ … (2)

With the information, Re is the average value of practicality questionnaire results, and Rh is the maximum average value of practicality questionnaires. The practicality assessment of digital comics developed is practical when it includes the ease of use of comics and students' interest in digital comics (Lestari and Ekawati, 2019).

The data obtained is then processed and qualified based on the criteria adapted from Rahmata and Ekawati (2021) below.

Table 3. Practicality Test Criteria

Practicality Value	Category
$85\% < P \leq 100\%$	Very practical
$70\% < P \leq 85\%$	Practical
$50\% < P \leq 70\%$	Less practical
$0\% < P \leq 50\%$	Impractical

3. **Effective**

The effectiveness test of digital comics is carried out on students by asking several questions regarding mathematical materials obtained from digital comics that have been read. Digital comics are effective if 75% of students meet the grades above KKM (Minimum Completeness Criteria). The established KKM value is 75.

RESULTS AND DISCUSSIONS

Data is obtained through the Addie research steps, which are then processed. The following is the result and discussion of the data that has been obtained and processed using the previously established method.

1. **Analyze**

At the analysis stage, interviews and analysis are conducted regarding the curriculum and school conditions. The analysis shows that MI Darul Huda Kota Mojokerto conducts PTM (Face-to-Face Learning) on a limited basis due to the Covid-19 pandemic. The interview results with the grade III teacher found that one of the materials to be taught was the standard weight unit conversion material.

Researchers then distributed the questionnaire of interest in comics to third graders. From questionnaires distributed to 20 students, it was found that 75% of students had read comics, and 60% of students were

interested in reading comics because of the images, while the other 40% were because of the storyline. Thus, it can be concluded that students are already familiar with comics and are interested in reading comics.

The next stage is a field study on ethnomathematics to be used. For example, the ethnomathematics concept of conversion of units of weight found in society is the habit of the Mojokerto people, who use cup doses to measure the weight of rice.

2. Design

In the design stage, the steps taken are compiling a comic framework in the form of scripts, menu page designs, reading guides, button designs, and character designs. The comic script contains storylines and character dialogues. The prepared storyline contains an ethnomathematics approach that has been established at the analysis stage. Dialogue between characters uses simple standard Indonesian so that students can easily understand. There are several menu options in the menu page design, namely 'Character introduction', 'KD and Indicator', and 'Start Reading'. In the choice of character introduction, readers can get acquainted briefly with the characters in the comics. Because the comics are intended for elementary school third graders, the characters in the story are also depicted in grade III elementary school. It aims to be able to attract the attention of students. Readers can see the KD and indicators learned in the comics in the' KD and Indicator' option. To start reading, readers can select 'Start Reading'. However, readers are first given a guide to reading digital comics, such as the direction of reading conversation balloons and guidance on the functions and how to operate the buttons contained in digital comics. The reader can operate several buttons, namely the button to the page before / next, the 'home' button is used to return to the comic title page, and the multiple-choice button to select the answer from the given question.

3. Development

The comics began to be developed based on pre-created designs and scripts. Creation uses PowerPoint, which is then converted into an application form (.apk) that can be installed on a smartphone. The screen ratio used is adjusted to the handphone screen size, which is 16:9 landscape. The font used is Comic Sans MS.

In digital comics, there are several interactive pages where students can choose a selection of answers from the given questions. A true or false response page will appear when students choose a choice of answers. If the answer is wrong, an explanation will appear, leading students to the right answer.

Figure 1. Multiple Choice Page

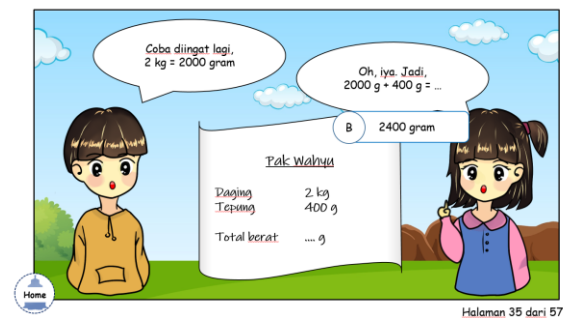Figure 2. Correct Answer Response Page

Figure 3. Wrong Answer Response Page

The digital comics developed contain ethnomathematics content, namely the habits of the Mojokerto people who measure the weight of rice using cups in buying and selling activities. This habit can still be found in traditional stalls.

Figure 4. Conversations About The Habit of Measuring Rice Weight Using Cups

At the development stage, the validation of digital comics has been created. Validators are two experts in mathematics and ethnomathematics learning media and material experts.

Table 4. Validation Questionnaire Results

No.	Aspects rated	Score	
		V1	*V2*
1.	**Media Aspects**		
	Clarity of the use of digital comics	3	3
	Ease of understanding digital comic plots	4	3
	The suitability of writing with pictures	3	3
	Language clarity and word selection	3	3
	The language used follows the cognitive development of students.	3	3
	The tenacity of presenting digital comics	4	3
	Use of sentences that do not contain SARA (ethnicity, religion, race, and inter-group relations)	4	4
	Accuracy of the terms used	4	3
	The appropriateness of the caption on the picture	4	3
	Stability of color and image quality	4	4
	Selected character according to student characteristics	3	3
	Attractive presentation of digital comics	3	3
	Answer selection panel resulting in students participating.	3	2
2.	**Material Aspects**		
	Conformity of digital comic content with Basic Competencies (KD) and Competency Achievement Indicators (GPA)	3	3
	Clarity of image with a conversational balloon in conveying the concept of unit conversion of weight units	3	3
	The truth of mathematical concepts is reviewed in terms of science	4	3
	Clarity of images and conversational balloons in conveying weight unit conversion material	3	3
	Ease of understanding the description of the weight unit conversion material	3	4
	The lack of presentation of the material	4	3
	Conformity of the degree of difficulty and integrity of concepts with the cognitive development of students	3	3
	Clarity of ethnomathematics context	2	3

From the results of the validation questionnaire, the total value of the questionnaire is 135 points, with the maximum value of the questionnaire being 168 points. The validity level of digital comics is obtained using the formula (1).

$$\text{Validity (V)} = \frac{\sum x}{M} \times 100\%$$
$$= \frac{135}{168} \times 100\%$$
$$= 80{,}35\%$$

The percentage results show that digital comics fall into the category of valid and need a little revision. In addition to providing assessments of digital comics, validators also provide criticism and suggestions. Digital comics were later revised according to criticism and advice from validators. The advice given by validators is to provide a variety of answer choices so that they are not only fixated on multiple choices. The revision provides various answer options where the reader can choose a character to answer the question.

Figure 5. Question Page By Selecting Characters To Answer

Validators also suggest adding body gestures to characters while speaking and adding illustrations in the presentation of standard unit weight conversions so that explanations are not only through conversational balloons. This illustration serves to sharpen the information provided by the conversation between the characters.
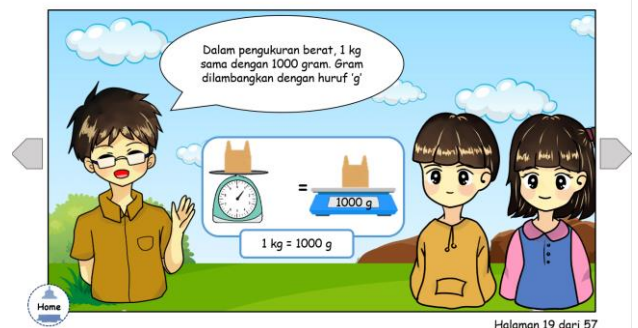

Figure 6. Addition of Illustrations

Input is also given to the reading guide section, where the guide is still unclear and needs to be added with illustrations so that readers can better understand the flow of reading comics. So that at the revision stage, the addition of illustrations in the reading guide section is carried out.

4. Implementation

Digital comics developed are then implemented in real situations to determine the level of practicality and effectiveness. The trial was conducted online due to the Covid-19 pandemic, which requires minimizing social contact. After reading the shared digital comics, students are then asked to fill out a practicality assessment questionnaire and given questions related to the conversion of raw weight units to test the effectiveness of digital comics.

Table 5. Results of Practicality Questionnaire

Assessed aspects	Score
Ease of use of digital comics	64
Clarity of digital comics usage guide	63
Interest in learning when using digital comics	69
Fun when studying with digital comics	66
Total Score	262

From filling out the digital comic practicality assessment questionnaire, the total scoring score is 262 points. The total number of students is 20 people, so the average score on the practicality questionnaire (Re) is 13.1, and the maximum average score (Rh) is 16. Therefore, using the formula (2) obtained practicality value for digital comics.

$$\text{Practicality (P)} = \frac{Re}{Rh} \times 100\%$$
$$= \frac{13{,}1}{16} \times 100\%$$
$$= 81{,}87\%$$

Digital comics fall into the practical category based on the results obtained. Then, students are given questions about the conversion of raw weight units from g to kg and vice versa.
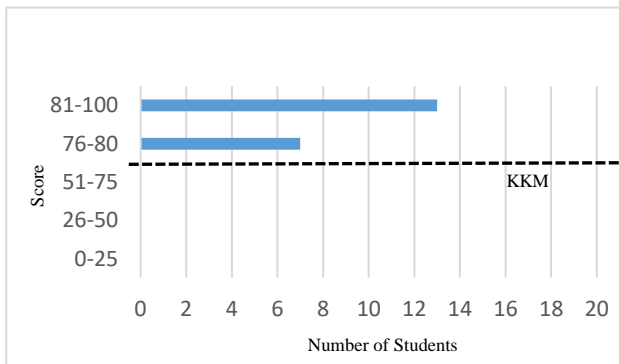
Graph 1. Student Grade Results

After reading digital comics, students can answer the given questions correctly because students have

understood the material in digital comics. As many as 100% of students get results above KKM on the effectiveness test. So is obtained the result is that digital comics can be categorized as effective.

5. Evaluation

Researchers then evaluated the results of digital comic. The following results were obtained after going through the validation, practicality, and effectiveness test stages.

    a)   With a validity assessment of 80.35%, digital comics fall into the valid category and need a little revision.

    b)   Based on the assessment results of the practicality of digital comics that students have filled, the percentage of the practicality of digital comics is 81.87%, with very practical criteria.

    c)   After reading digital comics, students are then given questions related to the material that has been read and can answer questions easily, and 100% of students get a score above KKM. Thus, digital comics can be categorized as effective.

CONCLUSION AND SUGGESTION
Conclusion

From a series of ADDIE stages that have been carried out, it was obtained that the digital comics developed met valid criteria with a percentage of 80.35% by both validators. Based on student response questionnaires, the practical value of digital comics is very practical, with a percentage of 81.87%. Digital comics that have been developed can be categorized as effective because 100% of students score above KKM. Ayuningsih's (2020) research shows the effectiveness of digital comics. The study found that the digital comics developed met the effective criteria with a percentage of student learning completion was 87.50%. This study showed a higher percentage of student learning completion. Therefore, it can be concluded that the digital comic media developed is feasible and can be used because it meets the criteria of validity, practicality, and effectiveness.

Ethnomathematics can be a student booster in studying mathematics because students are given examples of applying mathematics in everyday life. Therefore, digital comics mathematics with an ethnomathematics approach can be one of the bridges for students studying mathematics. In addition, the material learned does not feel 'unfamiliar' to students because the context used is taken from around the student and can be found in everyday life.

Suggestion

For the subsequent development of digital comics, researchers suggest adding other natural weight unit conversion materials other than kg to g so that digital comics can contain all-natural weight unit conversion materials for grade III elementary school. Researchers also suggest expanding the ethnomathematics context used, both from the Mojokerto area and other areas, so that students can get to know the culture in the community.

REFERENCES

Arsyad, Azhar. (2019). *Media Pembelajaran*. Jakarta: Rajawali Pers.

Arwanto, S.J. (2017). Eksplorasi Etnomatematika Batik Trusmi Cirebon Untuk Mengungkap Nilai Filosofi Dan Konsep Matematis. *Jurnal Pendidikan Mipa*.

Ayuningsih, D., Purwoko, R. Y., & Purwaningsih, W. I. (2020). Development of E-Comic as a Learning Medium With an Ethnomatematic Approach for Junior High School Students. *Proceedings Sendika*, 6(2).

Fahrunnisa, L., Adiansha, A. A., Irawan, A., Amrin, A., & Zulharman, Z. (2021). Pendekatan Etnomatematika: Bagaimana Pengembangan Media Komik Dalam Pemecahan Masalah Pada Pembelajaran Matematika SD?. *JagoMIPA: Jurnal Pendidikan Matematika dan IPA*, *1*(1), 56-64.

Fitriyah, D. N., Santoso, H., & Suryadinata, N. (2018). Bahan ajar transformasi geometri berbasis discovery learning melalui pendekatan etnomatematika. *Jurnal elemen*, *4*(2), 145-158.

Hiebert, J., & Carpenter, T. P. (1992). Learning and teaching with understanding. *Handbook of research on mathematics teaching and learning: A project of the National Council of Teachers of Mathematics*, 65-97.

Lestari, A. C. P., & Ekawati, R. (2019). Development Of Education Comics Based Realistic Mathematics Education On Fraction Material. *Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika (JRPIPM)*, *3*(1), 15-23.

Mawanto, A., Siswono, T. Y. E., & Lukito, A. (2020). Pengembangan Media Cerita Bergambar untuk Melatih Kemampuan Berpikir Kreatif Siswa pada Materi Pecahan Kelas II. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *4*(1), 424-437.

McCloud, S. (1993). *Understanding Comics*. Kitchen Sink Press Inc., Nothampton, MA.

Nisa, Z. E. K. (2019). Ethnomathematics Digital Comics (EDC) sebagai Media Pembelajaran untuk Meningkatkan Literasi Matematika dan Pendidikan Karakter pada Anak Usia Pendidikan Dasar.

McGriff, S. J. (2000). Instructional system design (ISD): Using the ADDIE model. *Retrieved November*, *24*(2020), 513-553. https://www.lib.purdue.edu/sites/default/files/directory/butler38/ADDIE.pdf

Rahmata, A., & Ekawati, R. (2021). Pengembangan E-Comic Matematika Berbasis Pendidikan Matematika Realistik (PMR) Bermuatan Etnomatematika Materi Aritmetika Sosial. *Jurnal Ilmiah Pendidikan Matematika Volume*, *10*(1).

Saraceni, M. (2003). *The Language Of Comics*. London: Routledge.

Sugiyono, M. P. P., & Kuantitatif, P. (2009). Kualitatif, dan R&D, Bandung: Alfabeta. *Cet. Vii*.

Tandililing, E. (2013, November). Pengembangan pembelajaran matematika sekolah dengan pendekatan etnomatematika berbasis budaya lokal sebagai upaya untuk meningkatkan kualitas pembelajaran matematika di sekolah. In *Dalam Prosiding Seminar Nasional Matematika dan Pendidikan Matematika diselenggarakan pada* (Vol. 9, pp. 194-202).

Wicaksono, S. (2016). The development of interactive multimedia based learning using Macromedia Flash 8 in accounting course. *Journal of Accounting and Business Education*, *1*(1), 122-139.

Widoyoko, Eko Putro. (2009). *Evaluasi Program Pembelajaran*. Yogyakarta: Pustaka Belajar.