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Development of Electronic Handouts Using Numerical Literacy-Based Mathemagics Methods for Learning in the Digital Era

Meria Ultra Gusteti^{1*}, Suci Wulandari², Widdya Rahmalina³, Melani Putri⁴, Elva Kurnia Putri⁵ ^{1,2,3,4} Mathematics Education, Universitas Adzkia, Indonesia.

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ABSTRACT

This research is motivated and conducted to address the problem of low numeracy literacy among students and the limited electronic-based learning media with game-based methods. The urgency of this research is crucial because low numeracy literacy can affect students' ability to solve mathematical problems in their daily lives and the future. The lack of engaging learning media can also affect students' interest in learning. Therefore, this study aims to develop an electronic Mathemagic handout based on numeracy literacy. The development model used in this research is the DDD-E model. The developed handout product has been validated twice by material and media validators. After revising it based on their suggestions and inputs, the average validation score obtained is 87.1%. These results indicate that the developed electronic Mathemagic handout based on numeracy literacy meets the perfect validation criteria. The solution offered by this research is to develop an engaging mathematical learning media using game-based methods to improve students' numeracy literacy. It is hoped that the electronic Mathemagic handout based on numeracy literacy can help increase students' interest and learning ability in mathematics. As a result, students can be more confident and have sufficient ability to solve mathematical problems in their daily lives and the future. The study implies that educators and policymakers can consider implementing the electronic Mathemagic handout in their teaching methods to enhance students' numeracy, literacy, and interest in mathematics. Additionally, the study underscores the importance of using innovative and engaging approaches in teaching to foster a love for learning and improve academic outcomes.

Keywords: Electronics handout, Mathemagics method, Numeracy literacy, Digital era

INTRODUCTION

Apart from being a medium for transferring knowledge, education develops students' critical thinking skills. Currently, education is expected to be able to produce students who have competitiveness, can face challenges, and play a role in the societal change in Era 4.0 and the Era of Society 5 (Novitasari, 2022); (Sabri, 2019); (Aini et al., 2020). To realize this, a strong foundation is needed in the form of learning with the concepts of literacy and numeracy (Skwarchuk et al., 2014); (Lefevre et al., 2010); (Fitriana & Ridlwan, 2021).

Numerical literacy is one of the six basic literacy skills that must be mastered by students in the 21st century (Cahyanovianty & Wahidin, 2021); (Feriyanto, 2022). Early numeracy literacy learning activities can help lay the foundation for positive outcomes in the future (Džumhur, 2022); (Calvo & Barrioluengo, 2016); (Aunio & Niemivirta, 2010). Indonesian students need to strengthen numeracy literacy. This refers to facts from various national and international surveys showing students' numeracy literacy has not increased significantly and

*Correspondence:

Meria Ultra Gusteti, Mathematics Education, Universitas Adzkia, Indonesia.

🖂 email : <u>meria.ug@adzkia.ac.id</u>

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has even tended to decrease and was exacerbated by the Covid-19 pandemic based on PISA (Program for International Student Assessment) data. Indonesia in 2015 was ranked 63 out of 72 countries based on the PISA survey. This condition is caused because the learning process must still lead to numeracy literacy. In addition, the material discussed could be more relevant to the student's environment. The learning media used have also not been adapted to the needs and conditions of the current digital era (Perdana & Suswandari, 2021); (Perdana &

Learning with online, offline, or blended systems forces educators to innovate to create quality and fun learning (Sulisworo et al., 2020). The role of the media, especially digital-based ones, determines how well learning takes place (Gusteti et al., 2021). Abstract characteristics of mathematics require media to transform it into concrete and close to students' daily lives as the principles of numeracy literacy (Rifandi et al., 2020); (Putri et al., 2022); (Gusteti et al., 2020); (Perdana & Suswandari, 2021).

The low numeracy literacy of students in Indonesia, based on the data above, and the limited electronic or digital-based teaching materials are problems that need to be solved. One solution to improve students' numeracy literacy is to collaborate with electronic handouts using the Mathemagic method based on numeracy literacy. Handouts are material sheets that assist educators in conveying material and enriching students' understanding (Ningtyas et al., 2014); (Septiadi et al., 2020). Learning in this new standard era requires digital-based media, one of which is electronic handouts so students can easily use them anywhere and anytime (Sari et al., 2022). Electronic handouts are electronic versions of handouts accessed via devices or computers and designed with the help of software (Nurjanah et al., 2021). Electronic handouts can collaborate with the Mathmagics method, which presents mathematics in a fun way. To increase students' desire to use electronic handouts, we need a learning method that is interesting, concrete, and close to students' daily lives, one of which is the Mathmagics method. Setvono said that Mathmagics is a method and a new perspective on mathematics, especially in how it delivers material (Wahyunita, 2017). The material is presented in a fun, concrete way and pays attention to psychological aspects, how the brain works, learning styles, and students' personalities (Wahyunita, 2017). The development of handouts using the Mathematics method based on numeracy literacy is expected to create learning that is close to the environment and fun so that it impacts increasing students' numeracy literacy.

This research is essential for supporting the National Literacy Movement (GLN) through the School Literacy Movement (GLS), adapting learning in the digital era, increasing numeracy literacy, developing science and technology, and preparing superior human resources. GLN and GLS have the goal of increasing literacy in reading, writing, and counting in Indonesia, which is in line with the primary objective of this research, which is to increase students' numeracy literacy through the development of numeracy literacy-based Mathematic electronic handouts (Gusteti et al., 2022). Using exciting and innovative learning media, as was done in this study, it is hoped that it can increase students' interest in and motivation to learn mathematics (Nurjanah et al., 2021). In addition, this research is also in line with the vision of Indonesian education to produce intelligent, skilled, and highly competitive human resources in the era of globalization and digitalization (Pangesti, 2018). Thus, this research can positively contribute to education development in Indonesia and inspire further study in numeracy literacy and technology-based learning media.

Several studies on the development of math handouts that are valid, effective, and practical are critical to improving students' learning activities and learning outcomes in mathematics. Various studies have been conducted previously, which found that using math handouts, such as mathemagics, can improve students' mathematics learning outcomes significantly compared to students who do not use math handouts. This shows that the development of math handouts that are effective and appropriate for use can help students

improve numeracy literacy and achieve better learning outcomes (Gusteti, 2022; Jamil et al., 2021; Nurjanah et al., 2021; Septiadi et al., 2020; Setyowati, 2013). Thus, this research has the potential to provide significant benefits in increasing the effectiveness of mathematics learning through using numeracy literacy-based Mathemagic electronic handouts. In addition, this research can also contribute to the development of learning models that are more innovative and oriented towards the use of information and communication technology in the context of education in Indonesia.

Based on the description, there is a need to develop new solutions to improve students' numeracy literacy. For this reason, this research has a novelty in developing electronic handouts that use the mathematics method based on numeracy literacy. To face the challenges of learning in the digital era, researchers aim to develop an electronic handout that can help improve students' numeracy literacy. Using the numeracy literacy-based Mathmagics method, the researcher hopes this handout can be a practical and effective solution in improving students' math skills. This research is expected to provide solutions for teachers and students to overcome the problem of low student numeracy literacy and the lack of attractive learning media in the digital era. In addition, this research can also contribute to developing innovative and effective teaching materials to increase student learning activities and outcomes in mathematics. This study aimed to create electronic handouts using the Mathemagic method based on numeracy literacy, valid for learning in the digital era.

METHODS

This research is Research and Development (RnD). Development model of research and development by choosing the DDD-E model. This model is specifically designed to develop multimedia learning. There are four steps: Decide, Design, Develop and Evaluate. 1) the Decide step is deciding or setting learning objectives and materials; 2) the Design step is designing or designing; 3) Develop step is producing media 4) Evaluate step is checking the design and development process thoroughly (Lukman et al., 2019).

In the decision step, what to do is to determine the topic or material, learning objectives, scope, and form of multimedia and analyze the media. The design step is thinking visually by producing the product and compiling maps on topics, content outlines, etc. Next is the development step, namely developing the product into electronic or digital handouts. The materials that have been prepared are illustrated into electronic handouts, which are arranged with several elements such as writing, pictures, animation, video, and audio.

After the electronic handout is developed, the next step is to validate the handout. Material experts and media experts carried out validation to ensure the validity and quality of the electronic handouts. During the validation process, the electronic handout was revised based on the suggestions provided by the validators. Evaluation continues at each stage of development to improve the quality of the electronic handouts that have been developed. This is important to ensure that electronic handouts meet the standards set and can provide optimal benefits in the learning process.

This study uses a questionnaire as a data collection instrument using a Likert scale as a measurement guide. The Likert scale used in this study consists of five answer choices that will be resolved. The Likert scale can measure individual or group behavior, comments, and assumptions about events or social indications. Using a Likert scale in this study makes it possible to obtain data that can provide a deeper understanding of the perceptions and attitudes of respondents toward the phenomenon under-researched (Rifandi et al., 2020).

The validation of this handout involved three experts: design experts, materials experts, and linguists. The data collection technique uses a validation sheet with scoring guidelines based on a Likert scale. The scoring guide can be seen in Table 1, which gives a score from 1

to 5, with five being "Very Good" and 1 being "Very Less" (Sugiyono, 2013). A formula is used to get the final score from the validation results: dividing the score obtained by the maximum score and multiplying by 100% (Akbar, 2013). The results of the average score of each aspect assessed will be converted into qualitative data based on the validity score guidelines.

Based on the validity score guidelines, the developed electronic handout can be categorized as quite valid if it reaches a validity percentage level between 61 and 80%. The validity category is based on a percentage range, where percentages of 81-100% are categorized as "Very Valid," 61-80% as "Quite Valid," 41-60% as "Less Valid," and 0-20% as "Invalid. " Therefore, if the developed electronic handout reaches a level of validity in the excellent category, it can be concluded that the handout meets the expected validity criteria for use in learning (Akbar, 2013).

RESULTS AND DISCUSSION

Results

Electronic Handout Validation Results

This research and development results are electronic handouts using the Mathemagic method based on numeracy literacy for learning in the digital era. The electronic handout is then validated to determine the feasibility of the product. The validation carried out was material validation by material experts and media validation by media experts. The validation aims to see the validity of the materials and media in electronic handouts using the numeracy literacy-based Mathmagics method for learning in the digital era.

There are seven indicators to assess the validity of the material in electronic handouts. The indicators used are 1) the suitability of the material with the daily life of students, 2) the suitability of the material with the level of development of students, 3) the suitability of the material with the competencies to be achieved, 4) the suitability of the games presented with the material presented, 5) the ease of use understanding of the material presented, 6) the attractiveness of the material presented, and 7) the delivery of the material well through electronic handouts. These indicators help assess whether the material in the electronic handout is relevant, according to the abilities and needs of students, and can provide an exciting learning experience. About these indicators, it is possible to fully evaluate the material's validity in electronic handouts and ensure that the material presented meets the expected quality standards.

The indicators for assessing the validity of the media are 1) the suitability of the display with the background, 2) the suitability of the animation with the material being discussed, 3) the suitability of the text and animation, 4) the suitability of the accompanying music with the material, 5) the quality of the animation is clear and attractive, 6) good quality electronic handouts, 7) illustrations that are easy to understand and relevant to everyday life, 8) contents of electronic handouts that are arranged systematically according to the material, 9) proper and adequate layout of electronic handout pages, and 10) media capabilities to support the various learning styles of students. By using these indicators, a comprehensive assessment of the validity of the media in electronic handouts can be carried out, thus ensuring that the media used meets the expected quality standards and can provide a practical and enjoyable learning experience.

Indicators for assessing the validity of the language aspect in electronic handouts There are several indicators used by Indonesian language lecturers, namely: 1) the accuracy of the sentence structure used, 2) the effectiveness of the sentences used in conveying the message, 3) the ease of understanding of the message conveyed, 4) the accuracy of the use of grammar, 5) the accuracy of the spelling used, 6) the use of appropriate terms, 7) the ability to encourage

students to think critically, and 8) the suitability of the language used with the intellectual development of students. Using these indicators, a comprehensive assessment can be carried out on the validity of the language aspects in electronic handouts, thus ensuring that the language used is by the expected language standards and can optimally support students' understanding and intellectual development.

Validity of electronic handouts Based on assessments from media experts, material experts, and linguists, the electronic handouts developed using the numeracy literacy-based Mathmagics method for learning in the digital era are declared very valid. This validity can be seen in Table 1, which displays the validation results of the three experts. The validity of this electronic handout shows that the material presented, the use of media, and aspects of language have met the established standards so that they can be used effectively in learning. Thus, this electronic handout can be relied upon as a quality learning resource and supports the improvement of students' numeracy literacy in the digital era. The results of the three experts' validation are presented in Table 1.

Validator	Validation Aspect	Score	Value	Criteria
1	Media	43	88.0%	Very Valid
2	Material	30	85.7%	Very Valid
3	Language	35	87.6%	Very Valid
Average			87.1%	Very Valid

Table 1. Expert Assessment Results

Based on Table 1, an analysis of the results of the expert assessment of electronic handouts was carried out using the numeracy literacy-based Mathmagics method for learning in the digital era. The validation results for the media aspect show a value of 88.0% with very valid criteria. Likewise, the validation results of material aspects produce an average value of 85.7% with very valid criteria. Furthermore, the validation results on the language aspect obtained a value of 87.6% with very valid criteria. From these three aspects, an average value of 87.1% was obtained with very valid criteria. This electronic handout has been validated with valid results based on the average value obtained. The handout can be used as a quality learning resource in learning mathematics. The validity of this electronic handout also opens opportunities for further research to explore its potential and benefits in more depth.

Electronic Handout Description

The electronic handout was developed using the Mathemagic method based on numeracy literacy. This handout has an attractive design with attractive graphic elements and colors. Mathematical materials are presented visually and interactively, enabling students to explore mathematical concepts in a fun way. In addition, this handout is equipped with clear and easy-to-understand instructions for use, so students can easily access it via smartphone and use it in the learning process.



Figure 1. Cover and Structure of an Electronic Handout

Figure 1 is a screenshot of an electronic handout that has undergone validation. The first image shows the initial view of the electronic handout, where users are greeted with an attractive interface that displays math material with a touch of mathemagics. This attractive and attractive design aims to arouse students' interest in mathematics. The second image shows the menu available in the electronic handout. This menu includes various essential features, such as profiles, Basic Competencies, Indicators to be achieved, instructions for use, and materials and evaluations. With this menu, students can easily explore the various content available in electronic handouts and access the information needed for learning mathematics. Overall, these electronic handouts offer an interactive, engaging, and easily accessible learning experience for students.

At the validation step, the validator provides input related to the product, namely: about navigation and use of electronic handouts, namely providing clear and easy-to-understand instructions for help so that students can efficiently utilize the handout. The validator also suggests that the content be adapted to the curriculum and can support the achievement of essential competencies. The suitability of the material with students' development level is considered again. The language validator suggests using language that is clear on mathemagics concepts. The validator also suggests adding relevant and exciting games or activities to electronic handouts to increase student interactivity and involvement.

In the validation process, several revisions have been made based on the input provided by the validator. These revisions include adding instructions to the start menu, adding music, and adjusting content (integer) to the context of the real world and games, in addition to adding games or activities like math magic, "magic column numbers," multiplication tricks, division tricks, square root tricks, and cube roots. The developed electronic handout has been validated and provides an attractive final appearance and relevant content. Shows that the electronic handout is ready for use in mathematics learning in the digital era, providing easy and attractive access for students to improve their understanding of mathematical material using a mathemagics approach.

Discussion

This research produced electronic handouts using the Mathemagics method based on numeracy literacy for learning in the digital era, which proved valid from the material, media,

and language aspects. This finding can be linked to several relevant studies. First, Nurjanah et al. (2021) found that electronic handouts can support teaching materials in achieving learning objectives. Furthermore, Perdana & Suswandari (2021) show that numeracy literacy-based learning can provide a fun learning experience and stimulate students' imaginations.

Research by Fitriana & Ridlwan (2021) emphasizes that numeracy literacy-based learning provides opportunities for students to engage in authentic problems and improve their skills. In addition, Pangesti (2018) states that developing students' numeracy literacy is critical in the school curriculum. Furthermore, Feriyanto (2022) shows that one of the strategies for developing students' numeracy literacy literacy is to provide learning support infrastructure.

Although this study yielded significant findings, some limitations need to be considered. This research still needs to be continued by testing the practicality and effectiveness of the electronic handout product being developed. The practicality test will evaluate how these electronic handouts can be applied in authentic learning environments. In contrast, the effectiveness test will measure how these electronic handouts can improve students' understanding and achievement. Therefore, further research needs to involve a more comprehensive sample and in-depth measurements to understand better the potential and benefits of using these electronic handouts in learning mathematics in the digital era.

CONCLUSION

Based on the results of research and development of electronic handouts using the numeracy literacy-based Mathemagics method for learning in the digital era, it can be concluded that the validation of the development of electronic handouts as a whole is stated to be very valid with an average validity level of 87.1% from material, media and language experts. This research contributes to enriching a creative and interactive approach to learning mathematics. This research implies the importance of innovative technology and approaches in designing exciting and effective teaching materials. Furthermore, this study also provides directions for further research in testing the practicality and effectiveness of this electronic handout. Continuing research at this stage will further strengthen our understanding of the benefits and potential of electronic handouts in supporting effective mathematics learning in the digital era.

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