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Development and Validation of E-Comic-Based Interactive Learning Media for Elementary Education

Khairunnisak, *Sumanti, Rambang Muharramsyah

Postgraduate Program of Almuslim University (PPs Umuslim), Bireuen-Aceh, Indonesia
*E-mail: sumanticantik34@gmail.com

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ABSTRACT

This study aims to develop interactive learning media with an economic basis and assess its validity and reliability. Using a developmental study approach or Research and Development (R&D) with the ADDIE framework (Analysis, Design, Development, Implementation, and Evaluation), the study focuses on designing and validating e-comic-based learning media for elementary students. Data collection methods included observations, interviews with teachers and principals, documentation, and triangulation. The analysis employed both qualitative and quantitative techniques using SPSS version 29.0. The findings reveal that the e-comic learning media and its usage guidebook are valid and reliable. The e-comic achieved an average validity score of 4.129 (84%) with a Cronbach's alpha of 0.96, reflecting high inter-rater agreement. Similarly, the guidebook scored an average validity of 3.72 (83%) with a Cronbach's alpha of 0.90, demonstrating excellent reliability. These tools address students' low interest in traditional learning methods by offering an engaging and accessible medium aligned with curriculum standards. The media fosters critical thinking, literacy, and problem-solving skills while reducing students' reliance on gadgets for non-educational purposes. his study highlights the potential of e-comic media as an innovative solution for enhancing elementary education. Further study is recommended to explore its adaptability to other subjects and its long-term effects on learning outcomes.

Keywords: *E-comic, Interactive media, Learning innovation, Elementary education, Digital learning tools.*

INTRODUCTION

Education is one of the most essential means to enhance the quality of Human Resources (HR), especially in facing the current global competition. It serves as a learning process aimed at achieving detailed understanding and knowledge of specific matters. Education also plays a significant role in shaping individual behavior, enabling people to survive and interact effectively in their lives. It constantly demands that we keep up with advancements in Science and Technology (S&T), particularly in the field of Information and Communication Technology (ICT).

The 21st century is characterized by rapid and unpredictable changes in various aspects of life, including economics, transportation, technology, communication, and information. In this era, education is deeply intertwined with the dynamics of the Fourth Industrial Revolution (4.0), which shifts educational objectives to prepare students for an increasingly competitive world that emphasizes critical thinking and creativity (Scepanovič, 2019). Efforts to advance human resources inevitably improve the quality of a nation's education. Hence, prioritizing educational quality is paramount for any country.

Education is a deliberate and planned endeavor by individuals to realize their potential, whether in spiritual and religious development, self-control, or contributions to society and the nation. Among those most instrumental in enhancing human resources are educators (teachers). Teachers bear the responsibility of facilitating education and addressing challenges arising during the learning process (Ciampa *et al.*, 2023; Zhao *et al.*, 2023; Chang *et al.*, 2023). The current curriculum emphasizes student engagement, where learning activities aim to help students develop foundational knowledge and skills applicable to daily life. Therefore, teachers are not only expected to deliver lessons but also to strategize on how to effectively transfer knowledge ensuring students understand the material comprehensively.

With the rapid advancement of information technology, tools like gadgets and the internet have become widely used, not just for communication but also for entertainment. This trend affects not only adults but also children, who now often prefer gadgets over reading books or engaging in other educational activities. Consequently, children spend more of their study time on gadgets and interactive media. This scenario calls for teachers to design and deliver classroom lessons tailored to student's interests and needs, facilitating their ability to achieve the desired learning objectives. Teachers should strive to create a safe and conducive classroom environment, involve students in problem-solving activities, and provide supportive facilities to enhance learning experiences (Voltz *et al.*, 2010; Burden, 2020). Thus, in implementing the teaching process, teachers must foster a pleasant and engaging atmosphere that aligns with students' interests, needs, and learning styles.

Based on the explanation above and the current conditions in the learning process particularly in the teaching of Natural and Social Sciences many teachers have yet to utilize interactive learning media. Textbooks are often the sole source of learning, as observed during interviews and classroom visits conducted by the study at Elementary School 9 Sawang, North Aceh, on December 22, 2022. Findings revealed that traditional teaching methods and reliance solely on textbooks result in low student interest and motivation. However, students show greater enthusiasm and motivation when teachers incorporate interactive learning media, such as laptops connected to the Internet.

Comics, on the other hand, can sometimes lead to student disengagement, as some students focus solely on the appealing visuals without fully comprehending the content. They may even avoid reading the entire story, which reduces their ability to absorb the material effectively. This study aims to develop interactive learning media with an economic basis and assess its validity and reliability.

METHODS

This study employs a type of study known as developmental study or Research and Development (R&D) (Lederman & Maloney, 2003; Richey & Klein, 2005; Raij, 2007). According to Sugiyono (2015), R&D can be defined as a scientific method for investigating, designing, producing, and testing the validity of developed products. Sukmadinata (2009:164) describes R&D as a series of processes or steps aimed at developing new products or improving existing ones in a scientifically accountable manner. The development model utilized in this study is the ADDIE model, chosen for its simplicity compared to other models, making it easier for researchers to understand and

apply (Molenda, 2003; Muruganantham, 2015). According to Branch in Sugiyono (2015), the stages involved in developing learning media using the ADDIE approach include Analysis, Design, Development, Implementation, and Evaluation.

- Analysis Stage: The analysis stage identifies the importance of e-comic-based learning media in the current educational landscape by conducting a needs analysis. This includes curriculum analysis, content/material analysis, teacher and student analysis, as well as literature analysis. These evaluations provide the foundation for the development process.
- Design Stage: The design stage involves planning the product to meet the identified needs (Branch in Sugiyono, 2015). The product developed in this study is e-comic-based learning media. During this stage, the researcher formulates ideas and goals for the product, determining that the e-comic-based learning media will serve as a learning resource aligned with curriculum and material analysis, as well as student needs analysis. The characters in the e-comic include a family (father, mother, Andi, and Aisha), a teacher, and several students (Nurul, Dodo, and Uli). In the presentation of the e-comic, only background music is included without character dialogue to foster students' reading interest and improve their literacy skills.
- Development Stage: The development stage consists of three main activities: 1) Designing Prototypes – This involves the initial design of the product, including character illustrations, storylines, and backgrounds that align with the comic's theme. The product developed consists of e-comic learning media and a user guidebook; 2) Conducting Formative Evaluations – This entails validations conducted by five experts: language, content, graphics, instructional strategies, and educational technology. It also includes a Focus Group Discussion (FGD) involving practitioners and users; and 3) Revised Prototypes – Following validation, the product undergoes revisions based on feedback from validators and practitioners.

This study uses both quantitative and qualitative methods. Data collection methods include observations and interviews with fifth and fourth-grade elementary school teachers, and principals, documentation, and triangulation. The second data collection method involves conducting a literature review to generate ideas for the product to be developed. Finally, the product undergoes internal testing. Qualitative data is processed using SPSS version 29.0.

RESULTS

The development of this e-comic learning media adopts the R&D model, designed using the ADDIE framework, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. In this study, the process was completed up to the validation stage, involving several experts, including language experts, content experts, graphic design experts, educational technology experts, and instructional strategy experts. The stages undertaken in this study include:

3.1 Analysis

3.1.1 Curriculum and Content Analysis

In accordance with the structure of primary and secondary education curricula under the

Kurikulum Merdeka, the structure for elementary schools or their equivalents is divided into three phases: Phase A for grades I and II, Phase B for grades III and IV, and Phase C for grades V and VI. The Natural Sciences and Social Sciences subject (a combination of Science and Social Studies) is presented in a simplified manner to help students address and resolve future challenges in their lives. For this development, the researcher designed a learning medium to be implemented in Phase C, specifically for grade V. At this phase, the general learning achievement goals expect students to be introduced to systems, devices, and elements interconnected and operating under specific rules to fulfill particular functions. This is especially relevant to understanding how natural and social life are interrelated within the context of diversity. Students are expected to take action, make decisions, or solve problems related to everyday life based on their understanding of what they have learned.

The specific achievement targets include: 1) Familiarizing students with various economic activities in their communities and creative economies in their surroundings; and 2) Encouraging students to act or make decisions based on their understanding of local wisdom and its scientific values. The Learning Objectives Flow derived from these achievement targets are as follows: 1) To analyze Indonesia's geographical conditions as an archipelagic/maritime and agrarian nation, as well as to identify its natural resources; and 2) To examine the economic conditions and activities occurring around their residential areas.

3.1.2 Needs Analysis

Based on the characteristics and learning objectives of Natural Sciences and Social Sciences in elementary schools, students are guided and assisted to become responsible citizens. Through the learning process in Natural Sciences and Social Sciences, students are expected to develop according to their talents, interests, abilities, and environment while gaining various provisions for continuing their education to a higher level. Furthermore, students are encouraged to cultivate scientific attitudes, such as curiosity, critical thinking, and analytical skills, fostering wisdom in navigating their era.

The focus of Natural Sciences and Social Sciences learning is not on how much content students can memorize but rather on how effectively they can apply their knowledge. Interviews with the principal and grade V teachers at Elementary School 9 Sawang revealed that students' interest in Natural Sciences and Social Sciences learning remains low. This is attributed to the lack of interactive learning approaches, with textbooks being the sole source of learning. Learning activities are still dominated by conventional methods, with minimal student involvement (teacher-centered). Moreover, students today are more inclined toward gadgets, which offer more appealing features.

Given these observations, the development of e-comic-based learning media aims to stimulate students' interest in learning while helping them develop critical and analytical thinking skills to solve problems. It also seeks to spark their curiosity and enhance their competencies. Additionally, it aims to divert their attention from gadget addiction. Students can revisit the e-comic media outside school hours, providing flexible access to the material.

3.2 Design

Once the researcher determined the concept for the product being developed, the next

step involved designing the characters to be used in the comic. The researcher utilized one of the Comic Maker platforms, Pixton. The stages involved in designing the e-comic learning media include: 1) Determining the title of the comic; 2) Developing a storyline aligned with the material to be incorporated into the comic, as outlined in the previous analysis; and 3) Enhancing the visual presentation of the comic to ensure it aligns with the storyline.

3.3 Development

3.3.1 Designing Prototype

This phase refines the comic draft that has been designed. The steps in designing the prototype include:

- Determining the comic title: Based on curriculum analysis, the content for the comic revolves around Natural Sciences and Social Sciences for Phase C, grade V, specifically Chapter 7: "Daerahku Kebanggaanku" (My Region, My Pride) with the topic "Economic Conditions in My Region". The resulting title for the comic is yet to be finalized.
- Developing content references: To determine the comic's content, the researcher referred to various books relevant to the Natural Sciences and Social Sciences curriculum, including student handbooks from the Kurikulum 2013 (K13) and KTSP curricula. These sources include Student Book Theme 5, Grade V (Integrated Thematic Curriculum 2013, Jakarta: Ministry of Education and Culture, 2018), Natural and Social Sciences Grade V (Ministry of Education, Culture, Research, and Technology), and Social Sciences, Volume 6 (Erlangga Publishing).
- Designing the Learning Objectives Flow: The comic is designed to support learning in Natural Sciences and Social Sciences, particularly on economic activities related to geographical conditions. The learning objectives include: 1) Analyzing Indonesia's geographical conditions as an archipelagic/maritime and agrarian nation and identifying its natural resources; and 2) Examining the economic conditions and activities occurring in the students' surrounding environment. First, the characters are designed based on their roles. Next, a scenario is created following the storyline and material.
- Creating the comic structure: The comic aims to make learning more engaging while enhancing students' reading comprehension. The first step is determining the characters to be featured. Character design is the starting point for creating the storyline. Next, a scenario is developed to provide a clear sequence and meaningful dialogue between characters that explain the material. Finally, the background (setting) is determined, such as scenes where Andi and his friends are attending a Natural Sciences and Social Sciences lesson or visiting Andi's brother at the pesantren.
- Designing the comic layout: The final step involves refining the comic's visual layout. After character designs are completed, dialogue is added, and the background is adjusted to fit the storyline. The designs, initially created using Pixton Comic Maker, are downloaded in JPG format to maintain image quality. The images are then transferred to Canva for comic strip arrangement. To enhance presentation, the e-comic is hosted on an HTML platform, and the development includes a user guide for teachers and students. The completed comic is submitted to a team of expert validators and practitioners for evaluation.

3.3.2 Formative Evaluation

Formative evaluation involves reviewing the product design by subject matter experts or validators before its use. The validity stage employs an agreed-upon validation instrument consisting of: 1) 15 indicators for content feasibility; 2) 9 indicators for language aspects; 3) 6 indicators for instructional strategies; 4) 12 indicators for graphical elements, and 5) 3 indicators for usability. The validation aims to gather feedback from validators, including lecturers and teachers, to serve as input for evaluation. Based on the expert validation, the quantitative data showed an average score of 4 with a percentage of 84%, indicating that the e-comic-based learning media is suitable for use with minor revisions. The final step in this phase is revising specific areas as suggested by the validation team to enhance the product's design and functionality.

3.3.2 Revising Prototypes

Based on feedback from validators, revisions are made to improve the product's quality. Key revisions include: 1) Updating the title or cover page as suggested by language experts to make it more appealing; 2) Content experts recommended adjusting the placement of images on the cover to better align with the material and make it more visually engaging; 3) Educational technology experts advised softening the comic's background colors and revising certain dialogues. Additionally, the background map of the world on page 6 was replaced with a map of Indonesia to make it more relevant; and 4) Female student characters were updated with outfits including hijabs, based on suggestions from instructional strategy experts. After revisions, the comic draft was converted into PDF format and hosted online using HTML5. Graphical experts recommended adding background music that complements the comic without distracting students. The final e-comic can be accessed via a shared link, making it available on gadgets or Android devices.

3.3.3 Focus Group Discussion (FGD)

To perfect the product, the researcher conducted Focus Group Discussions (FGDs) involving practitioners and users. Participants included Rahmi, S.Pd., M.Si., and several elementary school teachers. The discussion concluded that the learning media is suitable for use, with added suggestions to include more material in the comic and incorporate evaluation tools for students.

3.3 Data Analysis Results

The final stage of this study involves analyzing the validity of the e-comic-based learning media and its usage guidebook. The validation process focused on assessing multiple aspects to ensure the reliability and effectiveness of the developed products. The results obtained highlight the overall feasibility and appropriateness of the media for educational use, aligning with prior study on the use of technology-integrated learning tools.

3.3.1 Validity of E-Comic-Based Learning Media

The validity of the e-comic-based learning media was assessed using an instrument that evaluated five aspects: content feasibility, language, the media's effect on instructional strategies, graphical design, and benefits or usability. A total of 45 indicators were used to

measure these aspects comprehensively. Based on the validation results, the e-comic obtained an average score of 4.129 and a validity percentage of 84%, indicating that the product is valid for educational purposes. This result aligns with the findings of Jayaraman & Aane (2024), who highlighted that interactive media could significantly enhance students' engagement and comprehension when aligned with curriculum objectives.

To ensure the reliability of the data, the Cronbach's alpha coefficient was calculated. According to Taber (2018), a variable is considered reliable if the Cronbach's alpha value exceeds 0.70. The reliability test was conducted using the Interclass Correlation Coefficient (ICC) method with a two-way mixed model, analyzed via SPSS version 29.0. The Cronbach's alpha value for the five validators was 0.96, indicating very high agreement among the raters. However, the consistency for single raters was 0.349, reflecting moderate reliability for individual assessments. These findings are consistent with Hoppenbrouwers *et al* (2016), who emphasized the importance of high inter-rater reliability to validate the usability of digital learning tools in primary education.

Previous studies, such as those by Kirchoff (2017), have also demonstrated the potential of comics to improve students' critical thinking skills and literacy, particularly when they incorporate interactive features and are aligned with curriculum standards. Thus, the e-comic developed in this study is considered valid and ready for implementation.

3.3.2 Validity of the E-Comic Usage Guidebook

The guidebook for the e-comic was validated against three aspects: organization, format, and language. The results revealed an average score of 3.72 and a validity percentage of 83%, indicating that the guidebook is valid and suitable for use. This is in line with the findings of O'Malley *et al*. (2005), who noted that well-structured guidebooks significantly enhance the usability of educational tools by both teachers and students.

Reliability testing of the guidebook yielded a Cronbach's alpha value of 0.90, demonstrating excellent reliability. The inter-rater agreement average was also 0.90, reflecting a high consensus among validators, while single-rater consistency stood at 0.529. These results support the findings of Alshumaimeri & Alharbi (2024), who stated that clear and concise guidebooks are critical for ensuring the effectiveness of media implementation in classrooms. The development of the guidebook and its validation results are consistent with study by Lynn *et al*. (1999), which highlighted the necessity of providing teachers with user-friendly instructional manuals to maximize the benefits of innovative teaching media. This is further supported by O'Malley *et al*. (2005), who argued that structured usage guides help reduce teachers' workload and ensure proper media integration into lesson plans. The validation and reliability analyses confirm that both the e-comic-based learning media and its usage guidebook are valid and suitable for educational purposes. The results align with several prior studies that emphasized the potential of digital media, such as comics, in fostering engagement, improving literacy, and supporting critical thinking (Lynn, 1999; Matuk *et al*., 2021). Furthermore, the high-reliability values underscore the robustness of the validation process, as highlighted in studies by Corso *et al* (2023). The findings contribute to the growing body of literature advocating for the integration of innovative digital tools in education, particularly those tailored to the needs of students and teachers. Future study may further explore the long-term impact of such tools on learning outcomes.

CONCLUSION AND RECOMMENDATIONS

This study concludes that the e-comic-based learning media and its accompanying usage guidebook are both valid, reliable, and suitable for use in educational settings. The e-comic successfully integrates curriculum content with interactive design elements, achieving an average validity score of 4.129 (84%) and demonstrating high inter-rater reliability with a Cronbach's alpha of 0.96. Similarly, the usage guidebook provides clear and comprehensive instructions, with an average validity score of 3.72 (83%) and a Cronbach's alpha of 0.90, indicating excellent reliability. These findings affirm that the e-comic can address the problem of low student interest in conventional learning methods by offering a modern, engaging, and accessible learning tool tailored to the technological tendencies of today's students. Furthermore, the alignment between the study problem, objectives, and conclusions highlights the consistency of the development process in meeting its intended goals. Based on these findings, several recommendations can be made. Academically, further study is encouraged to explore the long-term impacts of e-comic-based learning media on various aspects of student development, such as problem-solving skills, creativity, and collaborative learning. Additionally, future studies could investigate the adaptability of e-comic learning media for other subjects or educational levels, broadening its applicability and potential benefits. Practically, educators are advised to incorporate e-comic-based media into their teaching practices to foster a more interactive and engaging learning environment. Educational institutions should provide targeted training programs to equip teachers with the skills needed to maximize the use of e-comics and other digital learning tools effectively. Policymakers and curriculum developers are also recommended to consider integrating e-comics and similar innovative digital media into national education strategies, ensuring alignment with technological advancements and addressing the evolving needs of students. By implementing these recommendations, the e-comic-based learning media can be optimized and its benefits amplified, ultimately contributing to an enhanced educational experience for students, teachers, and the broader academic community.

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