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NUMERACY LITERACY E-COMIC MEDIA FOR EARLY CHILDHOOD: PROGRESS TOWARDS PRACTICAL APPLICATION

ROSITA WONDAL
NURHAMSA MAHMUD
UMIKALSUM ARFA
YULIA NOVITA SARI
KHAIRUN UNIVERSITY, TERNATE, INDONESIA

NATALINA PURBA
HERMAN HERMAN
UNIVERSITAS HKBP NOMMENSEN PEMATANGSIANTAR, INDONESIA

DESTI PUJIATI
UNIVERSITAS MUHAMMADIYAH PURWOKERTO, INDONESIA

VEBIYANTI NASIR
BUMI HIJRAH TIDORE UNIVERSITY, SOFIFI, INDONESIA

Abstract
This research prepares an application for solving the problem of children who have difficulty in numeracy literacy, using the Research and development (R&D) approach of the Borg and Gall model, which is modified with the subject of 25 children (5-6 years old) at PAUD Pembina 7 Ternate City. The application developed in this research aims to address the numeracy challenges faced by young learners in an engaging and interactive manner. By leveraging technology, the app provides a tailored learning experience that adapts to each child's pace and style. The modified Borg and Gall model allows for an iterative refinement of the application based on feedback and observations from the target group, ensuring its effectiveness and relevance to the specific needs of preschool-aged children. The results were based on several tests, namely the validity test from material experts (84%) in the excellent category, language experts (93.4) in the outstanding category, user/teacher experts (95.4) in the very good category, and media expert assessment (82%) in the good category. The assessment of student responses in the limited test stage was 83.71% good, 88.86% good, and 90.02 was the very good. Numeracy literacy-based e-comic media has been proven to help children distinguish some letters that are difficult to understand namely 'b, d, and p', and is feasible to use in early childhood education (PAUD). The effectiveness of e-comic media in enhancing numeracy literacy is further evidenced by its ability to engage young learners through interactive, visually appealing content. This innovative approach not only aids in letter recognition, but also fosters a positive attitude towards learning, potentially leading to improved overall literacy skills in early childhood. The successful implementation of this media in PAUD settings suggests its potential for wider adoption and adaptation to address other educational challenges in early childhood.

Keywords: E-comic, early childhood, numeracy literacy, practical application

INTRODUCTION

Literacy activities in Indonesia have been developed intensively to form literate citizens. Literacy is the ability to develop an individual's potential to achieve goals. Numeracy literacy was introduced in 2017 (Rakhmawati & Mustadi, 2022). Numeracy literacy skills in early childhood are essential for further child development and even the needs of the digitalization era. With literacy and numeracy skills developing early on, it is vital to help children develop themselves in the context of further learning at their education level. Children have no difficulty in solving everyday life, including the use of technological tools such as smartphones and computers (Blumenfeld et al., 1991; Davis-Kean et al., 2022; Grasby et al., 2020; Hu-Au & Okita, 2021; Herman et al., 2024). Literacy and numeracy competencies are fundamental competencies in the industrial era 5.0. These competencies are closely related to daily activities (Flores et al., 2020). 21st-century competencies include critical thinking, problem-solving, creativity, communication, and collaboration. To achieve these competencies, students must have adequate literacy and numeracy skills and begin to be taught and trained

because they are at the primary level (Artha et al., 2020). Learner literacy is a prerequisite for achieving 21st-century skills (Sinaga et al., 2023; Girsang et al., 2025). Numeracy literacy is one of the aspects assessed in the Minimum Competency Assessment (MCA) concerning the Program for International Student Assessment (PISA) as a good practice for international-level assessments (Iswara et al., 2022). Numerical literacy is the basis of solving problems in everyday life (Budiarti et al., 2022).

Children will easily follow the learning process at the next level of education if they have adequate literacy and numeracy skills. Numeracy literacy is essential for children to master. Low numeracy literacy can affect students' ability to solve problems. Lack of exciting learning media can also affect students' interest in learning (Gusteti et al., 2023). The Program for International Student Assessment (PISA) of Indonesian students assesses literacy skills. Indonesia remains relatively weak in terms of mathematical literacy. Indonesia is ranked 72nd out of the 78 countries surveyed; students' numeracy literacy has remained relatively high and tends to decline, exacerbated by the COVID-19 pandemic based on PISA data (Herman et al., 2022). This is because the learning process leads to numeracy literacy. In addition, the material discussed can be more relevant to students' environments (Gusteti et al., 2023; Tayem, 2020). In Indonesia, the Minimum Competency Assessment (MCA) program implemented by the Ministry of Education and Culture (MOEC, 2017) evaluates literacy, numeracy, and character development through surveys. The results are still poor and are still a concern. (Susanto et al., 2022). However, over the past two decades, there has been an emphasis on educational institutions to ensure that all children entering primary school are ready to learn (Wolf & McCoy, 2019) because children who have literacy skills tend to have good academic achievement (Moats, 1999). On the other hand, children's numeracy literacy skills require help from various factors (Salminen et al., 2021), and it is a complex task of cognitive and language processes (Nation, 2019).

Along with the rapid development of information and communication technology in the era of revolution 4.0, the government requires teachers in schools through the national literacy movement to be able to use digital technology and assess the validity of information obtained from digital sources. The biggest challenge in implementing digital literacy in schools comes from within the school, including teachers' inadequate abilities in the digital literacy field. In the development of the millennial generation in the 21st century, known as Generation Z, digital natives were born and grew up in the digital era, with ease of access and daily life surrounded by information and communication technology (Lestari et al., 2020; Purba et al., 2024). Teachers must design learning activities that integrate literacy and numeracy (Suryanti et al., 2024).

The development of numeracy literacy skills by parent figures at home and teachers in early childhood education (PAUD) schools is instrumental, as is the introduction of basic concepts of numeracy literacy, namely the introduction of the concepts of reading, counting, and writing at the beginning in children aged 3 to 6 years. Introducing early childhood into the reading stage is difficult. Teachers and parents have difficulty teaching children how to read. Reading difficulties in schools are challenging for teachers because many children have different abilities in one class (Auphan et al., 2020). On the one hand, teachers are required to be able to teach children to read (Puzio et al., 2020). Children with early decoding mastery have good reading comprehension (Nation, 2019). Picture text is needed with a loud voice in teaching children to read in the early stage so that children can see and hear the sound of letters deliberately spelled slowly so that their memory can capture the sound and shape of letter concepts (Ehri, 2022).

The ability of teachers to innovate in creating digital-based learning media based on the development of the 4.0 era and following the interests of contemporary children is needed to improve the quality of learning (Ansari et al., 2023). Teachers are expected to be able to create various innovative works that are up to date by the development of the century and do not get out of the needs of children, namely through play. It should be packaged as enjoyable as possible so that children feel happy because the media teachers use to introduce the learning content is engaging. Teachers must be creative, innovative, and current with digitalization in classroom learning. Teachers must find solutions in using good learning media to develop children's interest in reading so that they feel interested and becomet used to reading activities from an early age. E-comic is a breakthrough in innovative and creative learning materials in the era of digitalization 4.0 and is an integral part of ECD policies and practices around the world (Handayani et al., 2021; Melliyanti & Suniasih, 2022; Rahmawati, 2018), in the process of introducing letters that are difficult for children to understand, by creating a fun learning atmosphere. Picture books (comics) are an excellent pedagogical tool for the learning process (Rasi et al., 2021).

Effective e-comic learning media can improve **early** childhood life skills **(Indriasih, 2023).** With e-comics, children can increase language knowledge, such as vocabulary and grammar, improve reading comprehension, build critical thinking, increase creativity, and develop reading motivation (Wijaya & Ciptaningrum, 2020; Robbani, 2021). The development of e-comic media is urgently needed for desired by teachers and students in the learning process. Comic media is one visual media that can present material more interestingly, increase motivation, and present material more concretely so that children can absorb material more easily (Sujinah et al., 2023). The application of digital comic media in learning life skills in early childhood is expected to develop various aspects of development, namely cognitive, affective, and psychomotor. From the mental aspect, children can reason from stories in digital comics. The affective element in the story is that some comics contain life skills and characters that can indirectly shape children's personalities from playing digital comics. From

the psychomotor aspect, children who play digital comics with laptops or computers develop finger, hand, and gross and fine motor skills (Aini Indriasih, 2023). Qualitative e-comic media can improve life skills, facilitate learning, attract attention, and encourage children to remember material content more easily. Comics are among the popular readings favored by young people (Febriani et al., 2021). With e-comic media that children like and can easily access anywhere and anytime, children can learn about content that is difficult for teachers and parents to teach at home. Numeracy literacy is the ability to use various numbers and symbols related to basic mathematics to solve problems in everyday life (Ministry of Education and Culture, 2017).

The results of preliminary studies conducted on problem-solving in early childhood difficulties in letter recognition with the help of video media, such as research by several researchers (Galliussi et al., 2020; Tamanu, 2021; Sulaiman et al., 2023) emphasize research by examining children's difficulties in general, in this case, the entire alphabet, has not focused on more specific letter difficulties. However, this numeracy literacy-based e-comic video highlights the difficulties of the alphabet that are very urgent for children, namely the letters b, d, and p. Researchers conducted a preliminary study with observation and interview techniques conducted with early childhood education (PAUD) teachers in Ternate City about children's ability to understand numeracy literacy, especially in children's difficulties in understanding letters. It was found that early childhood children tend to have difficulty distinguishing the letters 'b, d, and small p.' The interview results show that teachers find it challenging to teach children to distinguish between small letters b, d, and p. Children tend to swap and guess the three letters, resulting in incorrect or reversed pronunciation, such as saying the letter 'b' as 'd' and vice versa. This aligns with research conducted by Bowles et al. (Bowles et al., 2014), which shows that the letters b, d, and p have similar shapes, therefire early childhood has difficulty distinguishing them. The numeracy literacy-based e-comic media for early childhood developed in this study in the form of illustrated stories with text in digital form to make it easier for children to visualize the letters b, d, and p so that by seeing impressions, children can understand the differences between the three letters, and recognize these letters. On the one hand, it helps teachers improve their quality of learning. The development of this e-comic media is different from other e-comics because it features a familiar figure of ants for early childhood and displays images of letter shapes with cherry fruit animations so that children can visualize the shape of the fruit and match it with the letter shape shown on the fruit. This requires the teacher's ability to innovate in creating digital-based learning media based on the development of the 4.0 era and following contemporary children's interests. Through numeracy literacy-based e-comic media developed by researchers can help problems with learning difficulties, especially the ability to distinguish small letters, b, d, and p, with the help of the canva application, which is easy for teachers to apply so that it can help improve the quality of education at the PAUD level. Therefore, it is essential to research numeracy literacy-based e-comic media development for PAUD children in Ternate City, which goes through several expert validations and limited trials. Even broad trials so that the e-comic media prepared are suitable for early childhood by achieving the goal of the problem at hand. Early childhood can help children distinguish lowercase letters, such as 'b, ' d, and' p, in a fun manner.

METHOD

RESEARCH DESIGN

The method used to achieve the research objectives is according to the formulation of the problem posed, namely the research and *development* (R&D) approach. Researchers used the Borg and Gall R&D model in this study (Borg & Gall, 2003). This model was modified into seven stages to suit the research needs better. The research steps are as follows:

FIGURE 1. RESEARCH STAGES

1) Potential and problems

Researchers conducted an analysis related to the difficulties experienced in early childhood in children's numeracy literacy skills. How important are these difficulties to be addressed? What media can be developed to overcome numeracy literacy problems? Can the development of e-comic media address children's problems?

2) Data Collection

Researchers conducted a literature review of previous research on the development of e-comic media for solving numeracy literacy problems in early childhood.

3) Product Design

Related to the previous research found in the literature study, it is time to design e-comic media that can help

early childhood numeracy literacy skills.

4) Design Validation

After designing the e-comic media, it was validated by several experts, namely material experts (PAUD) from lecturer (SW) early childhood education, Institute of Islamic Religion (IAN) North Maluku Province, linguists from lecturer (DR) Indonesian Language Education, Khairun University, users from teachers (YR) PAUD Pembina 7 in Ternate city, and media experts (DW) visual graphic design, College of Computer Science and Informatics Malang.

5) Design Revision

The e-comic media was revised based on input from several experts. The media expert revised the text writing on the media and the video background for the ant conversation. The input from the material expert was to add an overall display of alphabets equipped with a song so that it would be interesting for children.

6) Product Testing

The revised media was then tested. The test was conducted in two stages: limited field and classical field test. The limited field test was conducted on PAUD Pembina 7 group B children as respondents with a high intelligence level, moderate or less. The classical test involved respondents in this class consisting of 25 children. While watching e-comic media, the research team assessed the children's responses related to the impressions they watched.

7) The Final Result

At this stage, numeracy literacy-based e-comic media for early childhood was refined based on field findings. The level of effectiveness can be accounted for, and it has a reliable generalization value in solving children's difficulties in distinguishing the letters b, d, and p.

RESEARCH SUBJECT

The research was conducted at PAUD Pembina 7 Ternate City, which is in Tubo Village, North Ternate District, Ternate City, North Maluku Province, involving 25 students as research subjects consisting of 12 boys and 13 girls age range of 5-6 years who were permitted by parents to be used as subjects in the study. Twenty-five learners were selected based on purposive techniques with specific criteria, namely children who did not recognize the letters 'b, d, and p,' so the media used was effective. Because information collection was the primary purpose of the research, the data collection process was the most critical part. The reason for researchers conducting research in this school was the availability of adequate infrastructure to assist them in carrying out and completing trials on Literacy-numeracy e-comic media.

2.3 Research Instruments

The instrument used in this study is a validation sheet in the form of a questionnaire for material experts (PAUD), linguists, users (e a r l y c h i l d h o o d t e a c h e r s) , a n d media experts. The following is a blueprint of e-comic media validation indicators used in research as a standard for the feasibility of e-comic video products by 4 experts:

TABLE 1. EXPERT VALIDATION INSTRUMENT

No.	Aspects	Indicator
	User Instrument (Teacher)	
1	Child Development	Appropriateness of content to child development
		Appropriateness of illustrations with child development
2	Learning Materials	Clarity of font and flow instructions
		Appropriateness of font size and type
		The content is detailed and thorough.
		Ease of understanding the content
		Illustration suitability with the material
		Clarity of language for children
		Increase children's motivation
		Linguist Instrument
1	Conformity with Indonesian language rules	Spelling Appropriateness
		Grammatical accuracy
2	Communicative and interactive	Ease of language comprehension for children
		Communicative language
	Material Instrument (PAUD expert)	
1	Child development	Appropriateness of content to child development
		Appropriateness of illustrations with child development
2	Learning Materials	Clarity of font and flow instructions
		Appropriateness of font size and type

No.	Aspects	Indicator
		The content is detailed and thorough.
		Ease of understanding the content
		Illustration suitability with the material
		Clarity of language for children
		Increase children's motivation
		Media Expert Instrument
1	View	Cover attractiveness
		Concise and clear illustrations
2	Design of Text message	Clarity of instructions
		Clarity of content message
		Harmonious use of message and text color
		Character suitability
3	Image Design	Accuracy of images and text
		Image and content support
		Image quality
4	Design of animated messages and materials	Suitability of animation to the material
		Interactive media
		Audio and visual suitability
		Quality of e-comic products

In addition to the validation assessment carried out by experts on literacy and numeracy-based e-comic video products and revisions made based on the suggestions listed in the comments column of the validation instrument, e-comic video media product testing was carried out in small groups. Students' responses (early childhood) when viewing video displays were assessed when testing products in small groups. The following is a blueprint for assessing children's responses when viewing e-comic video shows.

Table 2. Assessment of Children's response through observation

No.	Aspects	Indicator
1	Children's enthusiasm for learning	Child's response when watching the show Motivated in learning (interest)
2	Ability to distinguish the letters b, d, and p	Able to distinguish the letters b, d, and p
3	Ability to understand the content	Able to retell the content of the story Able to answer questions

DATA ANALYSIS TECHNIQUE

The information collection techniques used in this study include questionnaires, interviews, and documentation to obtain reliable data. Research instruments were used in the data collection process. This research uses quantitative and qualitative descriptive data analysis. After data collection, samples were obtained using tools selected based on the requirements to address this research problem. The type of information described determines the data analysis process. The instruments were based on a Likert scale, evaluation guidelines obtained from feasibility tests conducted on media experts, subject matter experts, and student responses. The final target is an e-comic media validated and ready to be used to develop early childhood education quality in recognizing the letters 'b, d, and p.' In making decisions about the qualifications of E-comic media, a 5-scale conversion of achievement levels was used, which is presented in Table 3 below:

Table 3. Conversion of level achievement scale 5

Achievement Rate (%)	Assessment Scale	Qualification	Description
90%-100%	4,51-5.00	Highly Appropriate	No revision needed
75%-89%	3,51-4,50	Appropriate	Minor revision
65%-74%	2,51-3,50	Neutral	Revise as necessary
55%-64%	1,51-2,50	Not Applicable	Many aspects need revision
0%-54%	1-1-50	Highly Not Applicable	Redo the product

(Tegeh & Kirna, 2013)

RESULTS

The research began with initial observations and continued to the next stage after validation by material experts (PAUD experts), linguists, users (t e a c h e r s) , media experts, and children's responses while applying e-comic video playback. Assessment in terms of material (PAUD experts) refers to aspects of child development and learning materials. Assessment in terms of language refers to aspects such as conformity with Indonesian language rules and communication and interaction. The assessment of users (teachers) refers to child development and learning materials conducted by two teachers. Assessment by media experts refers to aspects: display, text message design, image message design, and animation message design with material carried out by one animation media expert. Children assessed children's responses as a sample of 10 children whom three observers assessed with seven indicators of child response assessment, which included children sitting quietly, enthusiastically asking questions, children can distinguishing the letters 'b, d, and p,' retelling the contents of the e-comic story, understanding the contents of the story, liking the animation, and being interested in watching again.

Some things still need to be corrected in media preparation. The comments and suggestions from the media expert: On Display: The illustrations are interesting, but the content is less concise. It has been suggested that more straightforward examples exist other than fruit. From a basic form, a circle, and a line, students can more easily write/replicate the shapes in addition to understanding the differences. In ant animation, some ants move while others remain still. The main media is video animation, not e-comic. The animation still looks *green screen* (in the animation on the ant's antenna).

Based on the feedback received, the researchers redesigned the e-comic video. The video was redesigned based on experts' opinions, and the validation results were declared good, with minor revisions to be continued at the next stage. The revised e-comic video can be seen at the link: https://tinyurl.com/ekomikLiterasiNumerasi. An example of e-comic video footage was revised and tested in small/limited and classical groups, namely PAUD Pembina 7 Ternate City. The visualization of the e-comic video can be seen as follows:

FIGURE 2. PRODUCT VISUALIZATION OF E-COMIC VIDEO

The e-comic video was created with the aim that children can distinguish small letters 'b, d, and p.' This video tells the story of a forest with beautiful scenery and a conversation between two ants: Sangdo and Yongpil. Sangdo brings a cherry to Yongpil. However, Yongpil saw that Sangdo had only one cherry. Yongpil wanted as many cherries as possible. Sangdo taught Yongpil that the cherries should be shared with the other ants so he should not be greedy. In the conversation between the two ants, they observed that the cherries looked like small letters 'b, d, and p' when the stalk of the cherries was moved to the left, to the right, and when the cherries were turned upside down, they became the letter 'p.' At the end of this story, the prologue says the moral message to children who watch the video that we should not be greedy; we must be able to share with others. It is also emphasized that video shows can make children know and distinguish the letters 'b, d, and small p'. The video ends with an exciting alphabet song with colorful letters.

The results of the second stage material expert assessment of numeracy literacy *e-comic* media using a Likert scale obtained scores from material experts (ECD experts) (13 questions), language experts (6 questions),

users/teachers (13 questions), and media experts (17 questions) with the following details:

Table 4. Expert Validation Results

No.	Expert	Total Score	Assessment Conversion	%	Qualification
1	Material (PAUD expert)	55	4.2	84	Good
2	Language	28	4.67	93.4	Very good
3	User (teacher)	62	4.77	95.4	Very good
4	Media	69	4.1	82	Good
	Average score		4.44	88.7	Good

Based on the media product research provisions developed, the media is feasible if it is at least in the good category. The product is said to be feasible in terms of material. This is reinforced by the material expert's statement that the product is worth testing. Table 2 is the result of validation from 4 experts. Visualization of Table 4 can be depicted in the following diagram:

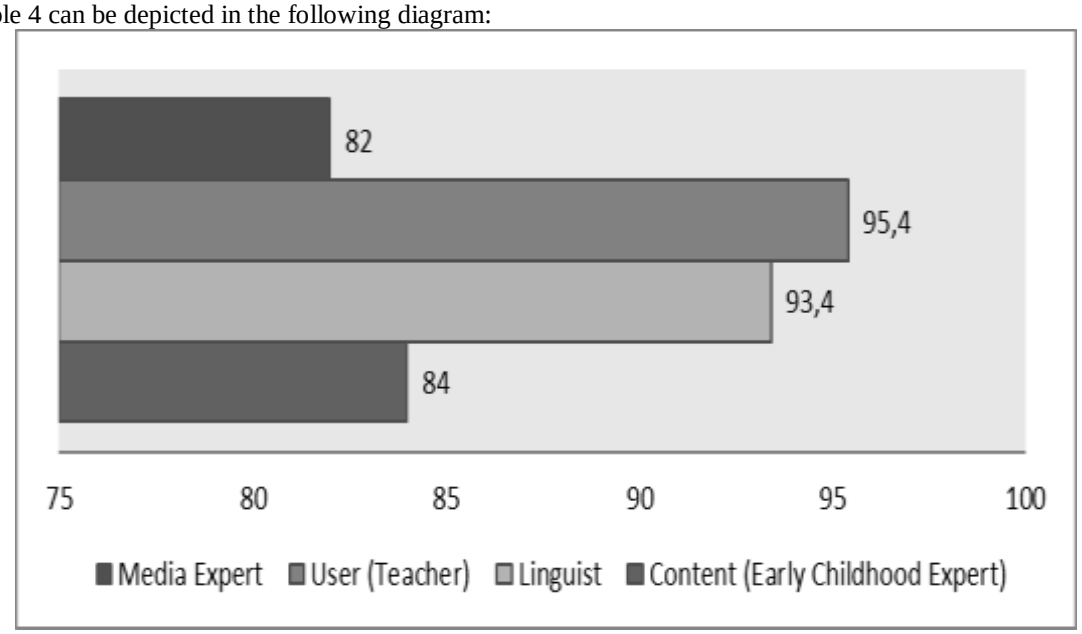

FIGURE 3. VALIDITY TEST PRESENTATION

In this case, the first expert on the material was an early childhood expert with two aspects and nine highlighted indicators to validate the material's relationship with child development and learning materials. The child development aspect had an average score of 5, and the material aspect had an average score of 4.09. These results were converted from the overall average of the assessment items of 4.2 (84%). This means that material content follows a child's development in an e-comic video. Media are considered suitable for implementation. The following validation was carried out with linguists on two aspects of assessment, and four indicators found that the aspect of suitability of the language rules used obtained an average score of 4.67 and communicative and interactive media obtained an average score of 4.67. Overall, the items on the assessment obtained an average score of 4.67, which was converted to 93.4, meaning that from the suitability of the rules of language used, communicative and interactive e-comic media are very good to apply.

The users were expertly validated by teachers of early childhood education. Two aspects with nine indicators related to child development and learning materials were validated. The aspect of child development had an average score of 5, and the aspect of learning material had an average score of 4.73, therefore, it is converted from the overall assessment of 4.77 (95.4%). This implies that in terms of material content and child development, the media is said to be very good for application.

Media expert validation was conducted with three aspects and 13 indicators. The display aspects received an average score of 4; text design obtained an average score of 4.2; image design of 3.67; and animation and material design of 4.14. The results of the overall validation assessment of the assessment items with an average value of 4.1 are converted to 82%. This means that in terms of media, e-comic videos are suitable for implementation.

FIGURE 4. EXPERT VALIDATION BASED ON ASSESSMENT ASPECTS

The *e-comic* media field test was conducted on Group B children from PAUD Pembina 7 Ternate City. The trial was conducted in two stages, a limited field test and an operational test. This trial was carried out by assessing student responses, which were assessed based on student response observation guidelines with indicators: 1) Children sit quietly in listening, 2) Children give questions (enthusiasm), 3) Children can distinguish the letters 'b, d, and p,' 4) Children retell the contents of the story, 5) Children understand the contents of the story, 6) Children like the contents of the story and 7) Children are interested in watching the show again.

1) Limited field test

First, a sample of 6 PAUD Pembina 7 group B children was used as the respondents. Students with high, medium, and low intelligence levels were selected as samples. The determination of respondents was based on the consideration of teachers and managers of PAUD Pembina 7. The trial was conducted on Tuesday, April 30, 2024. Respondents watched the e-comic video with the help of a laptop and LCD Projector. Based on the questionnaire results, the average presentation score of student responses with seven indicators was 83.71% (good).

Second, the Small Group Trial took a sample of ten PAUD Pembina 7 group B children as respondents. Students with high, medium, and low levels of intelligence were selected as samples. The determination of respondents was based on the consideration of teachers and managers of PAUD Pembina 7; the trial was conducted on Tuesday, May 07, 2024. Respondents, accompanied by the class teacher, watched e-comic shows on a laptop with the help of an LCD projector. Based on the results of the study, an average presentation of 88.86% was obtained, so the *e-comic* media developed was in a good category. If averaged over both sessions, this limited trial resulted in an outcome of 86.28% in the good category.

2) Operational trial (Classical test)

The operational (classical) stage of product testing involved PAUD Pembina 7 group B children which was conducted on Friday, May 10, 2024. The respondents in this class comprised of 25 children. The teacher and researcher guided the children in watching the e-comic video with the help of an LCD Projector. While watching the video, the research team assessed children's responses to their impressions.

The results of the respondents' assessments of the operational test are as follows:

1. The average value of respondents' assessment presentation was 90.02 (Excellent) based on the quantitative to qualitative data conversion table.
2. The observation results on the operational trial showed that students were interested and happy to learn using *e-comic*.
3. After being tested by the researcher, the child can distinguish the letters 'b, d, and p' well and correctly.

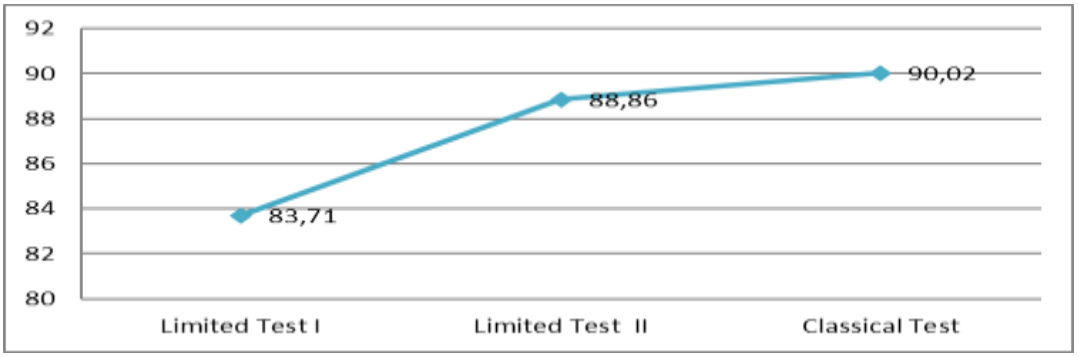

FIGURE 5. IMPROVEMENT IN CHILD RESPONSE

After the e-comic video media was designed and had passed the validation test, the next stage was to conduct a limited test of 2 meetings and a classical test. In this test, researchers conducted an assessment using observation techniques on the response of early childhood at PAUD Pembina 7 Ternate City. Figure 5 shows the results of the increase in children's responses to watching numeracy literacy-based e-comic video shows.

DISCUSSION

The development of Literacy-numeracy e-comic media for early childhood is presented with interesting impressions. This exciting presentation is expected to cause children to feel happy to learn while playing and motivate children to be more creative. *E-commerce* or digital comics are a new learning media for children so that children will like this media, and thus, children are motivated to learn. The application of the Literacy-Numeracy e-comic for young children is expected to develop various aspects of development, namely cognitive, affective, and psychomotor aspects. *The* cognitive aspect of the child can be attributed to the story in the *e-comic.* In this case, the child can think to distinguish the letters 'b, d, and p.' The affective aspect of the story in the Literacy-Numeracy e-comic also contains characters that can shape children's character indirectly from playing *e-comics*. The e-comic tells the story of ants who do not give up and want to share their cherries. For psychomotor aspects, children playing *e-comic* with a laptop or cellphone means developing finger skills and hand skills (fine motor).

The development of this Litarasi-Numerasi e-comic was carried out by analyzing the objectives of its development, analyzing capabilities, carrying out development procedures, and conducting expert validation. The goal of developing *e-comic* media is to produce *e-comic* media suitable for numeracy literacy learning materials for early childhood, which can increase motivation and help children learn. The *e-comic* media developed as multimedia in this research is used to present a visualization of early childhood life skills to be more concrete and exciting.

The preliminary study of the learning process of early childhood difficulties began with initial observations. It was revealed that teachers are still less creative in using media in learning activities at PAUD Pembina 7. The media used are only in the form of images presented with stories or lectures. Learning is less attractive for children to follow, and children find it challenging to visualize complex content, such as distinguishing the letters 'b, d, and p.' In order to increase children's motivation and interest in reading, children do not feel bored in participating in learning at school, and exciting media is used, namely *e-comics* or digital comics. The e-comic media design and validation results are classified as good with an average value of 4.44 from a 5-scale assessment and continued with a limited field test with a student response value of 86.28% with a good category and a classical test with a value of 90.02 (Very Good). It can be concluded that e-comic media can be generalized to overcome children's literacy difficulties in distinguishing letters b, d, and p. The following is a visualization of the class atmosphere during the classical test:

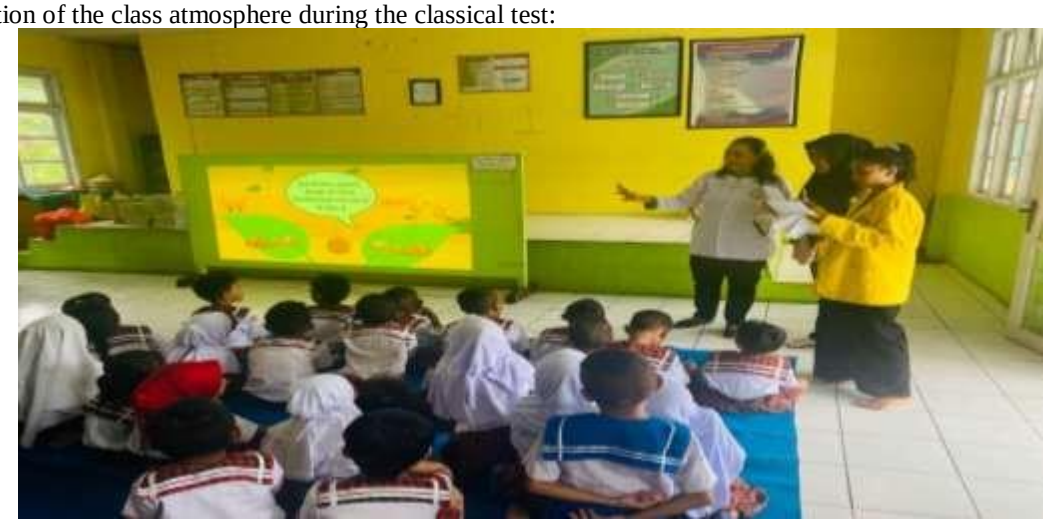

FIGURE 6. CLASSICAL TEST OF THE USE OF NUMERACY LITERACY E-COMIC MEDIA

Digital storytelling has several advantages over traditional storytelling. Digital storytelling's multimedia features can improve students' learning achievement. Increase motivation, commitment, and engagement, develop learning interests, and improve digital literacy (Al-Abdullatif, 2022). E-comic are interesting for children. With images, the delivery of the message is easier for children to understand and remember (Artha et al., 2020). Students have a very active character, like to play, and have tangible things. This shows that students do not like boring learning: therefore, teachers must have alternative media that can attract student interest. Therefore, e-comic learning media were developed to help teachers overcome learning problems, attract students' attention, and make students happy and passionate about learning (Fahreza et al., 2022).

The use of electronic comic media that uses images, text, and storylines can make it easier for children to understand various information or scientific messages in a way that is captivating, interesting, and supports learning (Artha et al., 2020; Fadilah, 2021; Murti et al., 2020; Radeswandri et al., 2021; Susanto et al., 2024; Yonanda et al., 2019). Interactive videos can be an effective intervention for developing kindergarten students' letter sound identification skills (Balauag, 2022; Cahyani & Rocmah, 2021; Khodijah et al., 2020; Reymalyn et al., 2021). Students who learn using comics are more motivated to learn than those who are not treated with learning using comics (Yonanda et al., 2019). Digital comics can improve students' reading skills because they are packaged into learning (Yuliati et al., 2023). Based on the development of numeracy literacy-based e-comic media and its application in PAUD Pembina 7 Ternate City, it has been proven that e-comic media is feasible and can help children recognize and distinguish the letters 'b, d, and p.

CONCLUSION

Numeracy literacy-based e-comic media can effectively improve early childhood's ability to understand and distinguish the letters b, d, and p. E-comic contains information that combines interactive elements to encourage early childhood to actively participate in learning and help children better understand the material. Based on several tests carried out, starting with expert validation, the material expert assessment with an assessment score of 4.2 (84%) is qualified with a good category, linguist assessment of 4.67 (93.4) with a very good category, user/teacher expert assessment of 4.77 (95.4) with a very good category and media expert assessment of 4.1 (82%) included in the good category. Meanwhile, the assessment of student responses in viewing impressions at the limited field test stage was 83.71% with a good category and a more comprehensive field test of 88.86% with a good category, and an operational test value of 90.02 in the field test stage was included in the v e r y good category. Thus, it can be concluded that the numeracy literacy-based *e-comic* media developed can make it easier for children to distinguish letters that are difficult for children to understand, namely lowercase letters; 'b, d, and p,' and are suitable for use in early childhood. This research contributes to the understanding of children's cognitive and language development.

The suggestion is that *e-comic* media can be applied in learning to help children develop numeracy literacy skills in early childhood. As a basis for consideration, f u n learning using *e-comics* can improve numeracy literacy skills during early childhood. The limitation of this study is that it is still limited to 3 types of letters that are considered alike by children; therefore, children have difficulty distinguishing. Therefore, this study can encourage further research on other content, such as introducing children to vocal and consonant letters more interestingly and interactively.

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