Ceria: Jurnal Program Studi Pendidikan Anak Usia Dini
Volume 14, Number 3, 2025 pages 762-795
P-ISSN: 2301-9905 E-ISSN: 2775-409X
Open Access: https://jurnal.umt.ac.id/index.php/ceria/index

Development of Educational Games *PERANGKA* to Improve the Numeracy Skills of Children Aged 5-6 Years

Liza Dian Arifina[1], Nurhenti Dorlina Simatupang[2], Yes Matheos Lasarus Malaikosa[3], Kartika Rinakit Adhe [4]

[1,2,3,4] Universitas Negeri Surabaya, Surabaya, Indonesia

e-mail: *[1]liza.21054@mhs.unesa.ac.id, [2]nurhentidorlina@unesa.ac.id, [3]matheosmalaikosa@unesa.ac.id, [4]kartikaadhe@unesa.ac.id

ARTICLE INFO

Article history:
Received: June 14, 2025
Accepted: September 30, 2025
Available online on: October 8, 2025

Keywords:
Educational games;
Numeracy skills;
Early Childhood

ABSTRACT

Low numeracy skills in early childhood remain a significant issue in children's education. One contributing factor is the lack of innovative and engaging learning media aligned with children's cognitive development stages. To address this problem, this research developed an educational game called *PERANGKA* (Number Train Game) as a learning medium to improve numeracy skills in early childhood. This study used a Research and Development (R&D) approach with the ADDIE model: Analysis, Design, Development, Implementation, and Evaluation. The game was developed based on Piaget's cognitive development theory, which emphasizes the importance of using concrete and visual media in children's learning. Additionally, Mayer's multimedia theory was applied in designing the game elements. The research subjects were Group B children aged 5–6 years at Kindergarten

Labschool Unesa 1 Surabaya. Data collection techniques included observation, expert validation questionnaires, and practicality assessments. The results showed that material experts gave a score of 93%, media experts 94%, and the practicality score from teachers was 90%. These findings indicate that the *PERANGKA* educational game is a feasible, effective, and engaging alternative learning medium for enhancing numeracy skills in early childhood.

Introduction

Early childhood experiences a very rapid development process and is fundamental to later life (Simatupang et al., 2023). In the age range of 0-6 years, children experience a golden age where almost 80% of brain performance is running (Putri et al., 2020). Children in the golden age experience the fastest growth and development in the span of their lifetime development (Panggabean et al., 2025). Aspects of growth and development such as, moral, intellectual, personality, physical motor, and social emotional experience the fastest growth during the golden age. The golden age period is a very fundamental period for the next life in the future (Sa'diyah, 2022). During the golden age, children need an environment that allows them to grow and develop optimally. Providing maximum and optimal stimulation can be done in educational institutions. Educational institutions that can provide services to help children get the right stimulation and guidance are Early Childhood Education (PAUD) institutions (Widayanti, 2016).

Early Childhood Education is a place of pre-school education

that helps guide and stimulate according to the characteristics and development of children (Oriza & Adhe, 2024). Early childhood education (PAUD) plays an important role in forming the foundation of children's cognitive, social, emotional and motor development (Kurniawan et al., 2025). The purpose of PAUD is to provide quality education and help children in the process of growth and development to prepare for school readiness at a further level (Tanu, 2019). Early childhood education (PAUD) based on Indonesian Law Number 20 of 2003, in the formal education sector is organized by kindergartens. The purpose of the learning program in kindergarten is to help shape attitudinal development (Suparti & Simatupang, 2014). In addition to the learning process at kindergarten institutions, teachers also provide stimulation that is able to develop all aspects of development. One of them is the aspect of cognitive development. Cognitive development is a process that occurs in a person's brain that produces the ability to think critically, analyze data, and solve problems with memory (Widayati et al., 2021). If children's cognitive is stimulated optimally and maximally, then children can process learning outcomes, improve logical thinking, and be able to solve problems.

Cognitive aspects in early childhood include numeracy skills, namely the ability to apply mathematical concepts and rules in everyday life. Numeracy skills provide an understanding of mathematical ideas and concepts that require speed and accuracy in thinking (Maulidiyah et al., 2025). This ability plays an important role

in achieving school success to prepare for the formal stage of numeracy at the next level of education. Numeracy skills are not only the ability to recognize number concepts, but also include the ability to think logically, solve problems, and also make decisions. Academic success, including in science and math, is linked to the success of children's numeracy skills at an early age (Watts et al., 2018). Moreover, numeracy is a foundational skill that covers every aspect of life and helps us become financially literate. Building numeracy from an early age is essential to form the foundation for lifelong learning (Romadhoni et al., 2021).

Numeracy skills have a very high urgency in this modern era. According to the National Council of Teachers of Mathematics (NCTM) in 2020, numeracy is the foundation for developing critical thinking and problem-solving skills. This is important so that each individual is able to analyze complex situations and make the right decisions. Based on the OECD (Organization for Economic Co-operation and Development) report in 2022, good numeracy skills allow a person to make more informed and rational decisions in various aspects of life, from economic to social. In addition, Maesaroh (2019) states that improving early childhood numeracy skills is necessary for preparation for further education, developing mathematical logic intelligence and improving overall learning ability.

Numeracy skills are very important for early childhood. However, these skills often receive less attention in early childhood education than

literacy skills. In Indonesia, the numeracy level is relatively low, as seen from the results of the Program for International Student Assessment (PISA) survey published in 2023. Indonesia's numeracy score is 366 points, 106 points away from the world average score (OECD, 2022). Indonesia's numeracy literacy skills are 71% below the minimum competency (Rizki & Fendiyanto, 2024). This shows the lack of knowledge of basic numeracy concepts, which are the foundation for 21st century skills such as critical thinking and data-driven problem solving.

At the early childhood education level, there are problems in numeracy skills. In fact, many children aged 5-6 years old have not reached the ideal level of numeracy skills. The results of observations at Labschool Unesa 1 Surabaya Kindergarten, out of 25 children at Kindergarten B level, 5 children still do not understand the concept of number symbols, 9 children cannot sort the symbols of 1-10 in order, 13 children still have difficulty calculating sums from 1 to 10, and some still have difficulty understanding comparisons, such as determining which objects are more. This is similar to research conducted by Nurlaela et al., (2021) who conducted a study at Bona Serang Kindergarten, showing that 60% of 55 students experienced limitations in visualizing numeracy concepts in everyday life. According to the research conducted. They have not mastered the skill of counting using fingers or other concrete objects as a representation of number.

The low numeracy skills are contrary to the ideal standard.

According to Piaget's cognitive development theory, children aged 5-6 years are in the preoperational stage, where they begin to develop a basic understanding of numbers and numeracy concepts, such as recognizing numbers, simple counting, and understanding simple relationships between numbers. Factors that cause low numeracy skills can be caused by a lack of innovation in learning and low active involvement of children during the learning process, which causes them to have difficulty understanding numeracy material (Fauziyah & Rakhmawati, 2023). Overcoming problems in children's numeracy development, the role of the teacher is needed to help develop children's numeracy skills. The role of the teacher includes creating a positive and comfortable atmosphere when doing numeracy activities, facilitating child-centered numeracy activities, designing innovative and meaningful numeracy activity development. One of the efforts to assist teachers in developing numeracy skills is by utilizing technology. Technology can assist the learning process by providing additional resources and tools that facilitate activities (Malaikosa et al., 2024).

Technology can be utilized as learning media. Learning media is divided into three based on the way of delivery and reception, namely, audio media, visual media, and audio-visual media. One approach that is considered effective is through games, because playing is a child's world and is a natural means in their learning process (Rismayani et al., 2025). The implementation of educational games can provide opportunities for children to develop knowledge, creativity, and

attitudes through the features and principles used in the game (Nikiforidou, 2018). educational games can arouse children's interest in learning, and provide interactive and fun learning (Pratama et al., 2019). Children feel challenged to solve problems when playing educational games.

Based on research conducted by Fauziyah & Rakhmawati (2023), it shows that the Numeracy Game (GANU) application with the STEAM approach improves children's numeracy skills. According to Raniah & Rakhmawati (2023), smart game applications can improve numeracy skills. Educational games that are specifically designed for children's numeracy development, such as number recognition, simple addition, and patterns, can be an effective means of building these skills. Research by Pan et al., (2020) showed that technology-based games can improve children's numeracy skills by up to 40%, better than using conventional learning methods.

Based on the urgency of numeracy described above and the results of previous research showing that educational games are proven to increase children's interest in learning, this research focuses on developing an educational game "PERANGKA" that has interactive elements and provides a fun play experience to increase children's learning drive, so that the learning process becomes more efficient. In the game "PERANGKA" developed using articulate storyline 3 software, it is expected to be an alternative solution to improve the quality of numeracy learning in PAUD, while providing a more

meaningful experience for children.

Methods

The type of research used is R&D (Research and Development) research. This research is a process or steps taken to develop new products or improve existing products (Judijanto et al., 2024). R&D in education is used to develop and validate educational products. The stages in R&D research include several critical steps from the beginning of the research to the product implementation stage (Sumarni, 2019). Products produced in R&D research can be in the form of software or hardware. The development in this study is in the form of educational games *PERANGKA* to improve the numeracy skills of children aged 5-6 years. The type of development to develop the product, the ADDIE development research model (Analysis, Design, Development, Implementation, Evaluation) is used. According to Branch in (Reza et al., 2020)ADDIE is one of the efficient models used to develop product frameworks. The ADDIE model was chosen because of its systematic approach that provides stages ranging from analyzing, designing, developing, implementing, and evaluating products.

The first stage in ADDIE development is analyzing the need for product development as well as analyzing the feasibility of the product. At this stage, identification of needs is carried out in the process of developing educational games to improve the numeracy skills of children aged 5-6 years. The analysis stage is carried out at Labschool Unesa 1 Kindergarten at the group B level. Based on the results of

observations, it shows that there are some class B children who have not reached the ideal level of numeracy skills, this shows the need for innovation in learning methods. Labschool Unesa 1 Kindergarten has never used educational game-based learning media in numeracy learning.

The second stage is design. At this stage the product design is still conceptual which will underlie the next process by making a storyboard. Product design is made based on data obtained through field observations. At this stage determining learning objectives and designing educational game media with storyboarding.

The development stage contains activities to realize the product design that has been made at the previous stage. At this stage it is necessary to make instruments to measure the feasibility and performance of the product, as well as assessed by media experts and material experts and will be revised to obtain validation. The final result at the development stage is a revised product ready for testing. Product trials were carried out by material experts and media experts to determine the feasibility of the products developed. Besides, The *PERANGKA* educational game was developed using *Articulate Storyline 3* and published in *HTML5* format to ensure compatibility across web browsers and devices such as laptops and tablets.

The fourth stage is implementation. The product will be implemented in Labschool Unesa 1 Kindergarten with a sample of 25 children aged 5-6 years. The purpose of implementing the product at

this stage is to obtain feedback on the product that has been developed. Feedback can be obtained by asking questions related to the purpose of product development through a questionnaire on the practicality of the game assessed by the class teacher.

The last stage is evaluation. The evaluation stage is carried out to provide feedback to product users. So that revisions are made according to the needs that cannot be met by the product. The final goal of this stage is to measure the achievement of the development objectives. After the validation stage from the experts, the product will be revised by considering the suggestions and criticisms that have been given. If the game is deemed suitable for testing, then the next step is to test the educational game that has been developed on users, namely children aged 5-6 years at Labschool Unesa 1 Kindergarten, Gayungan, Surabaya.

Research instruments are tools to obtain research data. The contents of the research instrument use a grid that is tailored to the needs of the researcher. The instrument in this study is a questionnaire. Questionnaires are data collection using written questions related to the scope of development to be studied (Risal et al., 2023). Data from the validation questionnaire is used in conducting evaluations to see the feasibility and practicality of educational game products for the numeracy skills of children aged 5-6 years. The questionnaire used in this study is closed, which is a questionnaire with questions that require short answers or only one answer from the respondent.

a. Material Expert Instrument

Table 1
Lattice of Material Expert Validation Instrument

No	Indicator Assessment	Aspect
1.	Suitability of Material	The suitability of educational game media material with children's characteristics
		The suitability of educational game media material with numeracy learning outcomes
2.	Presentation of content	The content chosen in the educational game media is interesting.
		Educational game media stimulates children's numeracy recognition by playing
		Educational game media can foster children's learning motivation
3.	Purpose	Educational game media can improve children's numeracy skills
		Educational game media

		can stimulate children's numeracy skills

b. Media Expert Instrument

Table 2
Lattice of Material Expert Validation Instrument

No	Indicator Assessment	Aspect
1.	Benefits	Ease of operating educational game media
		Accuracy of the selection of educational game media based on Articulate Storyline
2.	Color	The suitability of the color composition used in Articulate Storyline media
		Selection of colors used in educational game media according to the characteristics of early childhood
3.	Illustration	The suitability of illustrative images with the characteristics of early childhood

		Clarity of image illustrations in educational game media to support content
4.	Text Design	The suitability of the font and size of the text used in educational game media
		Appropriateness of text placement in educational game media

In the feasibility analysis using a Likert scale. The Likert scale is used to create instruments that assess the attitudes, perceptions, and opinions of people or groups about the possibilities and problems related to objects, designs, products, manufacturing processes, and products that have been designed (Sugiyono, 2015). The Likert scale provides clear answers, such as very good to very bad, so that respondents can provide answers that best suit their views. In addition, this scale allows quantitative data to be easily processed and analyzed, because each choice can be given a numerical value. Likert scale research instruments are arranged in the form of a checklist with the following criteria:

Table 3
Likert Scale Scoring Criteria

Description	Score
Very good	4
Good	3
Not good	2
Very not good	1

The range of scores used identifies positive and negative answers. To allow respondents to express their thoughts through comments in the completed questionnaire, neutral answers were omitted. Furthermore, descriptive analysis was conducted on the information collected from the questionnaires by the media and material experts. Meanwhile, data obtained from validation research and trials using a Likert scale questionnaire will then be analyzed by researchers using the following score percentage formula:

$$P = \frac{f}{n} \text{ x } 100\%$$

Source :(Sugiyono, 2019)

Description:

P : Percentage

f : Frequency of values obtained

n : Ideal value

100 : Constant

After the data is analyzed and the overall percentage score results are obtained from the various aspects assessed, the next step is to determine the feasibility of educational games. The percentage results will be converted to the quality of media feasibility. The following is a table of product feasibility criteria:

Table 4
Likert Scale Assessment Criteria

Percentage	Criteria	Description
76% - 100%	Very Good	Very feasible, without revision
51% - 75%	Good Feasible	Needs revision
26% - 50%	Not Good	Notfeasible, needs revision
0% - 25%	Very unfavorable	Very unfavorable, needs revision

c. Teacher practicality instrument

Table 5
Lattice of Teacher Practicality Instrument

No	Assessment	Indicator	Score (1-5)
1	Ease of Use	Children can easily understand how to play the game without excessive guidance	
		The navigator in the game is easy to understand and use	

2	Child Engagement	Game can increase children's involvement and motivation in learning numeracy	
		Children can play with focus and do not get bored easily	
3	Learning Effectiveness	Game helps children understand numeracy concepts such as number sequencing, patterns, counting operations, and number comparison	
		Game gives clear feedback when children answer right or wrong	
4	Visual & Audio Appeal	Game design is attractive, colors and animations are	

		suitable for children	
		Sounds and effects in the game are pleasant and not distracting	
5	Interactive Learning Support	The game can be used independently by the child	
		The game can be used as a learning tool	

Notes:

1 = Not Practical

2 = Less Practical

3 = Practical Enough

4 = Practical

5 = Very Practical

The teacher practicality assessment sheet instrument for the educational game *PERANGKA* uses descriptive quantitative data analysis techniques, by calculating the average score of each aspect assessed. The practicality of a product is measured based on user responses to several aspects, such as ease of use, efficiency, and applicability in real situations.

Table 6
Likert Scale Assessment Criteria

Description	Score
Not practical	1
Not very practical	2
Quite practical	3
Practical	4
Very practical	5

Result and Discussions

The analysis stage was conducted through direct observation in class B of the Unesa 1 Labschool kindergarten. Several numeracy problems were found in children aged 5–6 years, such as an inability to understand number symbols, sequence numbers 1–10, perform simple addition, and compare the number of objects. In addition, numeracy learning in that class did not yet utilize technology-based media. Based on these findings, interactive and enjoyable learning media are needed to enhance children's interest and numeracy skills. Therefore, the educational game *PERANGKA* was developed as a numeracy learning medium suitable for the characteristics of young children.

The learning objectives of this study include: children are able to sequence number symbols 1–10, perform simple addition, compare quantities using symbols <, >, and =, and sequence patterns A-B-C. These objectives form the foundation for designing the content and

activities within the game. The results of the student identification indicate that children are already familiar with number symbols and accustomed to using devices such as laptops or smartphones, making game-based media an appropriate choice.

TK Labschool Unesa 1 has five laptops and a Wi-Fi connection that support the implementation of the media. The learning strategy used is individual, where children play independently with the teacher acting as a facilitator. The activity begins with a pretest using the Child Worksheet, followed by treatment using the *PERANGKA* game for two sessions, and concludes with a posttest to measure the effectiveness of the media in improving children's numeracy skills.

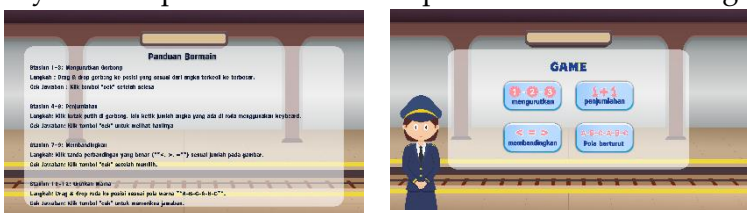
The design stage of educational games involves analyzing requirements, including formulating learning objectives, materials, product design, and measurement instruments. Product designs are created based on data obtained through direct observation in the field and are adapted to Piaget's theory of the preoperational stage and foundation phase learning outcomes, as well as Mayer's multimedia theory. The following is the design of the *PERANGKA* educational game, which has undergone a development design process:

Picture 1. Login Page and Main Menu

Picture 1 shows the design of the login page, which includes the game title, name field, and start button. It also shows the main page, which includes game icons, learning objective icons, and developer profile icons.

Picture 2. Learning Objectives and Developer Profile

Picture 2 shows a slide presenting the learning objectives for numeracy and the profile of the developer of the *PERANGKA* game.



Picture 3. Gameplay Guide and Game Menu

Picture 3 shows a guide on how to play the game. The game menu has four icons for each game material, namely number sequencing, addition, comparison, and patterns.

Picture 4. Number Carriage Sorting Game

Picture 4 shows a game about sorting number carriages according to the smallest number symbol or in order.

Picture 5. Arithmetic Game

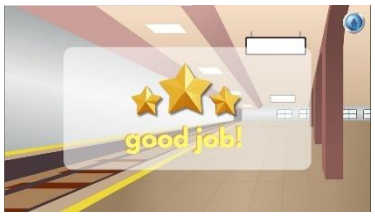
Picture 5 shows a simple arithmetic game, where children add up the numbers on each train car.

Picture 6. Comparison Game

Picture 6 shows a comparison game using the symbols "<" for less than, ">" for more than, and "=" for equal to.

Picture 7. A-B-C-A-B-C Pattern Sorting Game

Picture 7 shows a game of sorting train wheels according to the color pattern A-B-C-A-B-C.



Picture 8. Closing Page

Picture 8 shows the closing page with three stars, the words "good job," and an icon in the corner to return to the main page.

The *PERANGKA* game was developed as an interactive learning tool for children aged 5–6, using Articulate Storyline as the authoring platform (Indriani et al., 2022). In its design phase, illustrators produced custom graphics in Procreate to create engaging, child-friendly visuals that align with the game's learning objectives. The development followed a structured instructional design process: analysis of curriculum needs, design of game mechanics and art assets, development of content, implementation of the prototype, and evaluation—essentially an ADDIE-based R&D approach. During analysis and design, the team defined thematic learning modules centered on fundamental numeracy skills appropriate for kindergarten students. These themes included number recognition, basic counting, simple arithmetic, and other early math concepts, reflecting the objective of building fundamental knowledge and skills regarding numbers and geometric forms in early childhood education.

Each level of *PERANGKA* presents a different numeracy challenge (such as matching quantities, simple addition, or sequencing numbers) within a playful context, using the hand-drawn artwork to make tasks appealing and accessible to young children. Once developed, the game was published as an HTML5-based web product, allowing it to run in standard web browsers on multiple devices. This online deployment

ensured broad accessibility: for example, it could be played on classroom or home computers, tablets, or other internet-enabled devices without specialized hardware (Sari & Dewi, 2020).

The choice of a web format also reflected best practices in educational media, where access to common platforms (computers, tablets) is crucial for implementation. In practice, the game was tested on typical classroom media—tablets and laptops—to ensure that touch and mouse controls worked reliably and that animations and audio played smoothly.

Following development, PERANGKA underwent expert validation before classroom use. Both media experts and subject-matter (mathematics) experts from the Faculty of Education at Universitas Negeri Surabaya reviewed the game. This mirrored procedures in related studies, where faculty specialists assess new learning media (Dewi et al., 2021). For example, in one development study at the same university, educational technology experts validated a digital learning product with very high scores. In our case, the faculty reviewers examined *PERANGKA*'s content accuracy, educational value, user interface, and overall appeal. Their evaluations confirmed that the game met validity criteria and was highly engaging (Indriani et al., 2022).

Expert validation of the material was conducted by lecturers from the Early Childhood Education Department at the Faculty of Education, Surabaya State University, to assess the suitability of the game's content in relation to indicators including content relevance, presentation of

content, and learning objectives. Based on 7 statements, a score of 93% was obtained, indicating that the *PERANGKA* game is highly suitable for use in numeracy learning processes. Media expert validation was also conducted by faculty members from the same department to assess aspects such as benefits, color appeal, illustrations, and text design. The media experts provided feedback suggesting adjustments to features so that children can retry when answering incorrectly. The development team made revisions according to these suggestions. From 8 statements, media validation achieved a score of 94%, indicating that this media is highly valid as a learning aid for numeracy. The following table shows the results of the assessment by subject matter experts and media experts:

Table 7

Results of validation assessment by matter experts

No.	Aspects assessed	Item number	Score
1	Material suitability	1,2	8
2	Content presentation	3,4,5	10
3	Objectives	6,7	8
Total Score			**26**

$$P = \frac{f}{n}\ x\ 100\%$$

$$P = \frac{26}{28} \times 100\%$$

$$P = 93\%$$

Table 8

Results of validation assessment by media experts

No.	Aspects assessed	Item number	Score
1	Benefits	1,2	8
2	Color	3,4	8
3	Illustrations	5,6	6
4	Text design	7,8	8
Total Score			**30**

$$P = \frac{f}{n} \times 100\%$$

$$P = \frac{30}{32} \times 100\%$$

$$P = 94\%$$

The expert review also included qualitative feedback for improvement. Comments from reviewers were systematically used to refine the game design. For instance, common suggestions in such validation processes include improving layout clarity, adjusting the difficulty or pacing of tasks, and enhancing instructions or color contrast. Following recommendations, the development team revised the *PERANGKA* game accordingly (for example, by simplifying navigation and clarifying on-screen prompts) to improve its feasibility and usability. This iterative revision step is a standard part of educational media development; as Dewi et al. (2021) note, assessment or review results are used as a guide for revising the learning product to make it more feasible to implement.

During the implementation stage, researchers conducted product trials at Labschool Unesa 1 Kindergarten with a sample of 25 children

aged 5-6 years. When testing the game product, the children were given a brief explanation on how to play the game, such as how to select answers, press buttons, and complete the available challenges. The children then took turns playing the *PERANGKA* game using the laptops provided. When the activity began, the children showed high enthusiasm as they started playing the game. They gave positive responses both verbally and nonverbally, such as clapping their hands when their answers were correct. This indicates that the visual and audio elements in the game were sufficiently engaging for the children. After the game was finished, most of the children expressed a desire to play again, both verbally and through actions such as pressing the game icon again without being asked. This indicates that the *PERANGKA* game provides a numeracy learning experience that is both engaging and enjoyable for children. The practicality of the *PERANGKA* game was assessed based on the practicality evaluation forms filled out by two teachers from Class B. The evaluation results can be seen in the table below:

Table 9

Teacher Practicality Assessment Results

No	Assessment Aspect	Indicator	Score	
			Teacher 1	Teacher 2
1	Ease of Use	The *PERANGKA* game is easy for	4	4

		children to use without much help from adults		
		The game navigator is easy to understand and use	4	4
2	Child Engagement	The *PERANGKA* game can increase engagement and motivation in learning numeracy	5	5
		Children can play with focus and do not easily get bored	4	5
3	Learning Effectiveness	The game content is appropriate for the numeracy development of children aged 5-6 years	4	4
		The game can help children understand numeracy concepts such as number	4	4

		sequencing and patterns, addition operations, and comparisons		
4	Visual & Audio Appeal	The game design, colors, and animations are appealing to children	5	5
		The text size, icons, and buttons in the game are appropriate for children aged 5-6 years	5	5
5	Interactive Learning Support	The game can be used independently	4	5
		Games can be used as a learning aid	5	5

From the values obtained in the table above, the following is the calculation of the results of the analysis of the teacher's practicality assessment score :

$$P = \frac{f}{n} \times 100\%$$

$$P = \frac{90}{100} \times 100\%$$

P = 90%

The result of the assessment by the Class B teacher obtained from 10 statements is a score of 90%. Based on the score, the educational game products developed are included in the category of very practical to be used in the learning process of numeracy.

The last stage in the development of ADDIE is the evaluation stage, which aims to improve product deficiencies and user response in the use of educational game products. At this stage, it can be concluded that the results of the initial and final revisions indicate that there is no revision, so it can be stated that the educational game is feasible to use to improve the numeracy ability of children aged 5-6 years. The advantage of this game is that it can be accessed easily via html links without the need to download applications in the playstore.

Discussion

The results of the expert validation and practicality tests indicate that the *PERANGKA* educational game meets the criteria for valid, practical, and effective learning media for improving numeracy skills in early childhood. This finding aligns with Piaget's cognitive development theory, which emphasizes that children in the preoperational stage learn best through concrete and visual experiences. The visual and interactive elements of *PERANGKA*—developed through Articulate Storyline 3 and implemented in HTML5—provide a learning experience that is both meaningful and enjoyable for children.

These findings are consistent with previous studies, such as

Indriani et al. (2022), which found that educational games designed with the ADDIE model effectively enhanced numeracy understanding in preschoolers. Similarly, Fauziyah and Rakhmawati (2023) showed that the Numeracy Game (GANU) using the STEAM approach improved children's numeracy abilities, while Raniah and Rakhmawati (2023) reported that smart game applications supported numeracy learning outcomes. The high validation and practicality scores obtained in this study (93%, 94%, and 90%) strengthen the argument that digital games developed with child-centered design principles can effectively increase engagement and learning outcomes in early childhood education.

Furthermore, the HTML5-based deployment of *PERANGKA* allows for flexible access on multiple devices without installation, supporting the accessibility of learning media in both classroom and home environments. This aligns with the findings of Sari and Dewi (2020), who highlighted that web-based interactive media improves learning efficiency in early childhood education. Therefore, the *PERANGKA* game not only enhances numeracy skills but also contributes to digital literacy and independent learning habits in young children.

Conclusion

PERANGKA's educational games are developed through the ADDIE stage, with materials designed based on Piaget's cognitive theory and learning outcomes for children aged 3–6 years. The material includes sequencing numbers 1–10, simple summing, comparing

numbers using basic mathematical symbols, and A-B-C patterns. The illustration design was created using Procreate and integrated in the Articulate Storyline according to the principles of Mayer's multimedia theory. The final product is published in HTML5 web format for easy access via links or barcodes without additional installation.

Validation was carried out by experts to assess the feasibility of the material and media. The material validation obtained a score of 93%, indicating high feasibility in terms of content and learning objectives. Media validation received a score of 94% after revisions based on expert input, such as the addition of a repetition feature for incorrect answers. A practicality test from two kindergarten teachers showed a score of 90%, and the children's response to the game was very positive. These results confirm that *PERANGKA* is a valid, practical, and appropriate numeracy media for early childhood.

References

Dewi, W. S., Astutik, S., & A., P. (2021). Pengembangan Media Pembelajaran Interaktif Berbasis Articulate Storyline pada Materi Bilangan untuk Siswa Sekolah Dasar. *Jurnal Teknologi Pendidikan*, *23(2)*, 158–169.

Fauziyah, C., & Rakhmawati, N. I. S. (2023). Pengaruh Game Numerasi (Ganu) Menggunakan Pendekatan Steam Terhadap Kemampuan Numerasi Anak Usia 5-6 Tahun. *JP2M (Jurnal Pendidikan Dan Pembelajaran Matematika)*, *9*(2), 231-238. https://doi.org/10.29100/jp2m.v9i2.4419

Indriani, N. P., Safitri, N., & Rachmawati, D. (2022). Development of Educational Game to Improve Early Childhood Numeracy Skills Using ADDIE Model. *Journal of Early Childhood Education*, *10(1)*, 25–36.

Judijanto, L., Muhammadiah, M. U., Utami, R. N., Suhirman, L., Laka, L., Boari, Y., ... & Yunus, M. (2024). *Metodologi Research and Development: Teori dan Penerapan Metodologi RnD*. PT. Sonpedia Publishing Indonesia.

Kurniawan, A., Kuswandi, D., Aulia, F., & Badiah, L. I. (2025). Development of Digital Twin-based Learning Videos in Early Childhood Learning Media Courses. *Ceria: Jurnal Program Studi Pendidikan Anak Usia Dini*, *14(1)*, 1–18. http://dx.doi.org/10.31000/ceria.v14i1.13103

Malaikosa, Y. M. L., Saroinsong, W. P., & Widyaswari, M. (2024). PENGEMBANGAN MODUL AJAR KURIKULUM MERDEKA BERBASIS PJBL: PANDUAN PRAKTIS BAGI GURU PAUD. *IJCE (Indonesian Journal of Community Engagement)*, *5*(2), 149-159. https://doi.org/10.37471/ijce.v5i2.1035

Maulidiyah, E. C., Adhe, K. R., Widayanti, M. D., Safitri, D. G. L., Rahmawati, D., Nashirah, S. Z., ... & Syakira, R. A. (2025). Pengaruh Media Timang Terhadap Kemampuan Numerik Anak. *Jurnal Mutiara Pendidikan*, *5*(1), 16-27. https://doi.org/10.29303/jmp.v5i1.8634

Nikiforidou, Z. (2018). Digital Games in the Early Childhood Classroom: Theoretical and Practical Considerations. *International Perspectives on Early Childhood Education and Development*, *22*, 253–265. https://doi.org/10.1007/978-981-10-6484-5_16

OECD. (2022). *PISA 2022 Results: Vol. I*.

Oriza, N. I., & Adhe, K. R. (2024). Pengaruh Pembelajaran STEAM Terhadap Kreativitas Anak Usia 5-6 Tahun. *PAUD Teratai*.

P Pan, Y. J., Chen, Y. C., Lu, S. R., Juang, K. D., Chen, S. P., Wang, Y. F., ... & Wang, S. J. (2020). The influence of friendship on migraine in young adolescents: A social network analysis. *Cephalalgia*, *40*(12), 1321-1330. https://doi.org/10.1177/0333102420940700

Panggabean, M. L., Rambe, A. P., Afifah, H. U. N., & Lubis, H. Z. (2025). Arabic language learning through the singing method for early childhood. *Ceria: Jurnal Program Studi Pendidikan Anak Usia Dini*, *14(1)*, 82–93. http://dx.doi.org/10.31000/ceria.v14i1.13193

Pratama, L. D., Lestari, W., & Bahauddin, A. (2019). Game Edukasi:

Apakah membuat belajar lebih menarik? *At- Ta'lim : Jurnal Pendidikan*, *5*(1), 39–50. https://doi.org/10.36835/attalim.v5i1.64

Putri, R. S., Purwanto, A., Pramono, R., Asbari, M., Wijayanti, L. M., & Hyun, C. C. (2020). Impact of the COVID-19 pandemic on online home learning: An explorative study of primary schools in Indonesia. *International Journal of Advanced Science and Technology*, *29*(5), 4809–4818.

Raniah, D. A., & Rakhmawati, N. I. S. (2023). Raniah, D. A., & Rakhmawati, N. I. S. (2023). Meningkatkan kemampuan numerasi anak usia 5-6 tahun melalui pembelajaran STEAM dan bahan loose parts. *Journal on Education*.

Reza, M., Ningrum, M. A., Saroinsong, W. P., Maulidiyah, E. C., & Fitri, R. (2020). *Trial Design of Sexual Education Module on Children*. *503*, 108–110.

Risal, Z., Hakim, R., & Abdullah, A. R. (2023). *Metode Penelitian dan Pengembangan Research and Development (R&D)–Konsep, Teori-Teori, dan Desain Penelitian*. Batu: Literasi Nusantara.

Rismayani, R., Siregar, S. M., Adelina, H., & Lubis, H. Z. (2025). Games in Arabic for Early Childhood: A Literature Study. *Ceria: Jurnal Program Studi Pendidikan Anak Usia Dini*, *14*(1), 43-67. http://dx.doi.org/10.31000/ceria.v14i1.13178

Rizki, N. A., & Fendiyanto, P. (2024). *Pendampingan Mendesain Soal Literasi Matematika Model Pisa Dengan Pendekatan Etnomatematika (Konteks Sosial Budaya Masyarakat Kutai)*. *July 2023*. https://doi.org/10.15575/jak.v6i1.17697

Romadhoni, N. A., Fitri, R., & Setyowati, S. (2021). *NUMERASI DAN KEMAMPUAN MOTORIK HALUS PADA ANAK USIA 5-6 TAHUN*. 119–132.

Sa'diyah, S. A. (2022). Studi komparatif kompetensi profesional guru paud ditinjau dari latar belakang pendidikan. *JP2KG AUD (Jurnal Pendidikan, Pengasuhan, Kesehatan Dan Gizi Anak Usia Dini)*, *3*(1), 35–50.

Sari, P. K., & Dewi, R. (2020). Pemanfaatan Media Pembelajaran Interaktif untuk Anak Usia Dini di Era Digital. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *4(2)*, 795–803.

Simatupang, N. D., Widayati, S., Adhe, K. R., & Sholichah, S. A. (2023). *Pengembangan Buku Cerita Big Book Kalender Meja dalam Meningkatkan Kemampuan Literasi Anak Usia Dini*. *7*(1), 1130–1141. https://doi.org/10.31004/obsesi.v7i1.4067

Sugiyono. (2019). Metode Penelitian dan Pengembangan (R&D). *Bandung: Penerbit ALFABETA*, *(3)*, 15–20.

Sumarni, S. (2019). *MODEL PENELITIAN DAN PENGEMBANGAN (R & D) LIMA TAHAP (MANTAP) UNIVERSITAS ISLAM NEGERI*. 1–33.

Suparti, W., & Simatupang, N. D. (2014). *Meningkatkan Kemampuan Mengenal Konsep Lima Huruf Vokal Melalui Media Aplikasi Power Point Pada Anak Kelompok A*. 1–5.

Tanu, I. K. (2019). Penggunaan metode mengajar di paud dalam rangka menumbuhkan minat belajar anak. *Pratama Widya : Jurnal Pendidikan Anak Usia Dini*, *3 (2)*, 14–19.

Watts, T. W., Duncan, G. J., Clements, D. H., & Sarama, J. (2018). *What Is the Long-Run Impact of Learning Mathematics During Preschool ? 89*(2), 539–555. https://doi.org/10.1111/cdev.12713

Widayanti, M. D. (2016). PENINGKATAN KEMAMPUAN SERIASI UKURAN MELALUI PENGGUNAAN. *Jurnal Pendidikan Guru Pendidikan Anak Usia Dini Edisi 2 Tahun Ke-5 2016 228*, 219–228.

Widayati, S., Simatupang, N. D., Saroinsong, W. P., & Rusdiyanti, A. (2021). Pengembangan Media Stekpan Untuk Kognitif Anak Usia 4-5 Tahun. *Jurnal Anak Usia Dini Holistik Integratif (AUDHI)*, *4*(1), 8-17. http://dx.doi.org/10.36722/jaudhi.v4i1.698