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The Development of Domino Ceria Learning Media to Enhance Number Concept Understanding in Children Aged 4–6 Years

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ABSTRACT

Most children still have difficulty connecting number symbols with objects, ordering numbers, and performing simple arithmetic operations. This condition is exacerbated by limited availability of engaging learning media appropriate to early childhood development. Therefore, learning media development is needed. Domino Ceria (DORIA) is a set of domino cards with an attractive visual design used to improve understanding of number concepts in children aged 4–6 years. The research method used in this study is Research and Development (R&D) with the ADDIE model. The research subjects were Group B children of Trisula Perwari Kindergarten aged 4–6 years. The research instruments included needs analysis, expert validation, and effectiveness testing. The results showed that the Domino Ceria media met feasibility standards with an average percentage of 97.00% based on expert validation and proved effective in improving children's understanding of number concepts.

Keywords: *ADDIE, Early Childhood, Domino Ceria, Number Concept, Learning Media*

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INTRODUCTION

One of the essential aspects of early childhood cognitive development is the understanding of number concepts. This ability is fundamental because it forms the basis for the development of mathematical skills at later stages of education (Simatupang et al., 2023). Children aged 4–6 years are in the preoperational stage of cognitive development, a stage in which children begin to understand symbols and basic concepts, including number concepts (Novitasari, 2016). At this stage, learning experiences that involve meaningful interaction with objects and symbols are crucial in helping children construct their early mathematical understanding.

Various studies have emphasized the importance of developing number concept understanding in early childhood. According to Putri et al. (2022), a strong mastery of number concepts at an early age can predict children's future academic achievement, particularly in mathematics. Similarly, research conducted by Purpura et al. (2017) found

that children who demonstrate strong number concept understanding during the preschool years tend to show better mathematical performance when they enter elementary school. Furthermore, Ashari et al. (2023) argue that understanding number concepts in early childhood is not only essential for cognitive development but also plays a significant role in fostering logical thinking and problem-solving skills.

The use of appropriate learning media can support young children in understanding number concepts in a more meaningful and enjoyable way. Montessori emphasized the importance of using concrete materials in early childhood education to help children understand abstract concepts (Isaacs, 2018). Similarly, Reswita and Wahyuni (2018) highlight that appropriate learning media can significantly enhance children's comprehension of number concepts. However, the reality in many early childhood education settings shows that there are still challenges in teaching number concepts effectively.

Several previous studies have identified problems in the implementation of number concept learning in early childhood education. Learning activities are often dominated by conventional approaches that do not sufficiently involve play-based activities, resulting in children becoming easily bored and less motivated to participate in learning (Amalia et al., 2020). In addition, the limited availability of learning media that align with children's developmental characteristics often becomes an obstacle in fostering number concept understanding (Sa'ida & Yunitasari, 2021). Other studies indicate that many early childhood educators still face difficulties in developing effective learning media (Winda Pratiwi, 2024). This situation is further supported by findings that many early childhood education institutions lack innovative learning media that are suitable for children's developmental stages, particularly in supporting number concept learning (Mardhiah & Hikmah, 2021). The gap between expected learning outcomes and the realities in classroom practice highlights the need for innovative learning media that align with the developmental characteristics of young children.

In response to these challenges, several previous studies have explored the use of educational games as learning media to enhance number concept understanding in early childhood education. These include the use of mancala games (Wati et al., 2019), locally-based congklak games (Safira et al., 2023), educational cards (Jayanti, 2013), snakes and ladders games (Sari & Putra, 2020), mathematical monopoly games (Dade & Aulina, 2025), and picture cards (Rahmawati, 2020). Although these studies demonstrate the potential of game-based learning in improving children's mathematical understanding, they have not specifically examined the development of domino-based learning media to support number concept learning in early childhood education. Therefore, research focusing on the development of domino-based educational media for enhancing number concept understanding in early childhood is still limited and needs further exploration.

Domino Ceria is a modification of the traditional domino game designed specifically for children aged 4–6 years. This learning media combines attractive visual images with numbers or other symbols related to the learning material. The development of Domino Ceria follows the ADDIE model (Analysis, Design, Development, Implementation,

and Evaluation), ensuring that the media is systematically designed based on needs analysis, developed according to children's characteristics, implemented in real learning contexts, and evaluated for further improvement. The urgency of developing Domino Ceria learning media is also aligned with the educational paradigm of the 21st century, which emphasizes the importance of developing critical thinking, creativity, communication, and collaboration skills (4C) in learners.

Therefore, this study aims to analyze the needs, evaluate the feasibility, and test the effectiveness of Domino Ceria learning media in enhancing the understanding of number concepts among children aged 4–6 years at TK Trisula Perwari Purwakarta Regency. The novelty of this study lies in the development of domino-based learning media that integrates visual elements with number symbols designed according to early childhood cognitive development characteristics. Through this media, children are not only introduced to number symbols but are also trained to understand the relationship between number symbols and quantities, arrange numbers in sequence, and perform simple mathematical operations. Consequently, this research is expected to contribute to the development of innovative learning media that supports early childhood number concept understanding.

METHOD

Research Design

This study employed a Research and Development (R&D) approach aimed at developing and evaluating the effectiveness of an educational product. The R&D method is commonly used to produce or improve instructional products through systematic stages including needs analysis, design, development, and testing to ensure that the resulting product can be effectively implemented in the learning process (Hasyim, 2016; Setyosari, 2016). In this study, the R&D approach was used to develop Domino Ceria learning media, which is designed to support early childhood understanding of number concepts.

The development process followed the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. This model was selected because it provides a systematic framework for instructional product development, allowing the creation of structured and effective learning media (Tegeh & Kirna, 2013). Through these stages, Domino Ceria learning media was developed starting from needs analysis to evaluation in order to ensure its feasibility and effectiveness in enhancing children’s understanding of number concepts (Latief, 2009).

Subjects / Population and Sample

The research was conducted at TK Trisula Perwari, Purwakarta Regency, West Java Province, from October 2025 to February 2026. The research activities included coordination with the school, data collection, expert validation, and trials of the developed learning media.

The research subjects consisted of early childhood learners aged 4–6 years enrolled at TK Trisula Perwari. The participants were divided into two groups: Group A and Group B. Group A consisted of 15 children aged 4–5 years, while Group B consisted of 25

children aged 5–6 years. The selection of these groups was based on differences in children's cognitive developmental stages. Children in Group A are generally at an early stage of recognizing symbols and numbers, whereas children in Group B have begun to demonstrate simple logical thinking and a basic understanding of number concepts.

Data Collection Procedure

Data collection was carried out through several techniques, including interviews, observations, validation questionnaires, and learning outcome tests. During the analysis stage, a needs analysis was conducted to examine the current condition of number concept learning at TK Trisula Perwari. This analysis involved interviews with teachers and observations of classroom learning activities to identify the characteristics of children aged 4–6 years, the learning media currently used, and the difficulties faced by teachers in teaching number concepts.

In the design stage, the initial concept of Domino Ceria learning media was developed. Activities at this stage included determining learning objectives, formulating success indicators, designing the visual appearance of the learning media, and developing research instruments such as interview guidelines, observation sheets, expert validation questionnaires, and number concept understanding tests.

During the development stage, the design of Domino Ceria was transformed into a tangible product in the form of domino cards containing number concept materials. The developed media was then validated by material experts, media experts, and early childhood education practitioners using Likert-scale-based validation questionnaires. The validation process aimed to evaluate the content suitability, visual design, and usability of the media in learning activities. Feedback from experts was used to revise and improve the media before conducting field trials.

The implementation stage involved testing the use of Domino Ceria learning media in classroom learning activities. At this stage, children's understanding of number concepts was measured through pre-tests conducted before the use of the media and post-tests conducted after the learning activities using Domino Ceria. Additional data were collected through observations of children's learning activities and interviews with teachers to obtain information about children's responses, participation, and engagement during the learning process.

Data Analysis

The data analysis employed both qualitative and quantitative approaches. Qualitative analysis was used to process data obtained from interviews, observations, and expert feedback using the Miles and Huberman (2014) model, which includes data reduction, data display, and conclusion drawing.

Quantitative analysis was conducted to determine the feasibility and effectiveness of the developed learning media. The feasibility level of the media was calculated using a percentage formula comparing the obtained score with the maximum possible score (Maslich, 2016). Meanwhile, the effectiveness of the Domino Ceria learning media was

analyzed using pre-test and post-test results. The improvement in children's number concept understanding was measured using the Normalized Gain (N-Gain) score, which indicates the extent to which students' learning outcomes improved after the use of the developed learning media.

FINDING AND DISCUSSION

RESEARCH RESULT

This section presents the results of the development of Domino Ceria (DORIA) learning media designed to enhance the understanding of number concepts among children aged 4–6 years at TK Trisula Perwari, Purwakarta Regency. The development of this learning media followed the ADDIE development model. The research results begin with a needs analysis obtained through interviews with teachers and the school principal, as well as preliminary observations of the learning process related to number concepts. The findings from this stage served as the basis for designing the Domino Ceria learning media.

Table 1. Results of Interviews with Teachers and the School Principal

Aspect	Findings
Learning Method	Number concept learning is still dominated by conventional methods using children's worksheets and lectures. Learning activities are less varied and tend to be monotonous for children.
Learning Media	Limited availability of attractive and interactive learning media. Existing media are generally simple number cards and whiteboards. There is no educational game media specifically designed for number concept learning.
Children's Difficulties	Children experience difficulty connecting number symbols with the quantity of concrete objects, arranging numbers in sequence, and performing simple addition or subtraction. Children also tend to quickly lose concentration and learning motivation.
Teachers' Needs	Teachers need learning media that are: (1) game-based, (2) visually attractive, (3) easy to use, (4) suitable for group play, and (5) able to facilitate gradual understanding of number concepts.

Based on the interview results with teachers and the school principal of TK Trisula Perwari, number concept learning in the classroom still tends to rely on conventional approaches with limited activity variations. The available learning media have not yet supported interactive learning activities. This condition causes children to experience difficulties in understanding number concepts, particularly in connecting number symbols with the quantity of objects, arranging numbers sequentially, and performing simple arithmetic operations. Therefore, teachers emphasized the need for more engaging learning media that support game-based learning activities.

Table 2. Initial Observation Results of Children's Number Concept Ability

No	Indicator	Group A (n=15)	Group B (n=25)	Average
1	Recognizing number symbols 1–10	46.67%	64.00%	57.50%
2	Connecting number symbols with the quantity of objects	33.33%	48.00%	42.50%
3	Arranging numbers 1–10 in sequence	26.67%	44.00%	37.50%
4	Performing simple addition (result ≤10)	20.00%	36.00%	30.00%
5	Performing simple subtraction (result ≥0)	13.33%	28.00%	22.50%
	Overall Average			**38.00%**

Based on the initial observation conducted with 40 children at TK Trisula Perwari, the average level of children's understanding of number concepts was 38.00%. The highest achievement was found in the ability to recognize number symbols 1–10 (57.50%). Meanwhile, the abilities to connect number symbols with object quantities and to arrange numbers sequentially showed relatively lower achievement. The lowest achievement was found in simple arithmetic operations, namely addition and subtraction. In general, the performance of Group B was higher than that of Group A across all indicators.

Table 3. Draft Specification of Domino Ceria Learning Media

Component	Draft Specification of Domino Ceria Media
Media Name	Domino Ceria (DORIA) – Mathematics Domino for Early Childhood
Number of Cards	32 domino cards with various combinations of numbers 0–10 and object images
Card Size	6 cm × 13 cm with 3 mm thickness
Material	Thick laminated cardboard (matte finish), safe for children, water-resistant, and durable
Image Theme	Fish illustrations (cheerful characters) with bright colors: red, yellow, blue, green, and orange
Card Design	Each card is divided into two sections (top and bottom). Each section contains: a large number (1–10) sized 1.5 cm and fish images corresponding to the quantity shown by the number
Packaging	Storage box measuring 22 cm × 15 cm × 5 cm made of laminated cardboard with an attractive design labeled "DORIA"
Guidebook	A5 size (10–15 pages) containing instructions for playing, variations of the game, and teacher guidance

Game Levels	4 levels: (1) Matching numbers with the same quantity of objects, (2) Arranging numbers in sequence, (3) Simple addition, (4) Simple subtraction

The draft specifications of the Domino Ceria (DORIA) learning media developed during the design stage are presented in Table 3. The media was designed as an educational domino game that integrates number symbols with representations of object quantities to help children understand number concepts concretely. The design of the media considers the learning characteristics of early childhood by incorporating attractive visual elements and structured play activities. Furthermore, the game levels are organized progressively to facilitate children's understanding of number concepts, starting from number recognition to simple arithmetic operations. An illustration of the Domino Ceria card design is presented in the following figure.

Draft Doria 1 | Draft Doria 2 | Draft Doria 3

Figure 1: Domino Ceria media card display

During the development stage, the feasibility of the Domino Ceria media was measured through theoretical validation by experts and empirical validation through limited trials. Validation was conducted to ensure that the developed media met feasibility standards in terms of content/material, media design, and usability in early childhood learning. Validation of the Domino Ceria media involved three expert validators: two material experts and one media expert. The identities of the validators involved in the media validation process are presented in Table 4.

Table 4. Expert Validator Identity

NO	Name	Unit	Information
1	Dr. Dede Supendi, M.Pd	Dinas Pendidikan	Head of Primary Education / Material Expert
2	Cucu Susianti, M.Pd	TK Al Akhyar	BAN Assessor / Media Expert

3	Cucun Yunianingsih, M.Pd	TK Plus Roudoh	Principal / Early Childhood Education Practitioner (Material Expert)

Table 5. Expert Validation Results for Subject Matter 1 (Dr. Dede Supendi, M.Pd)

NO	Assessment Aspects	Score	Percentage
1	Compliance with basic PAUD competencies	5	100%
2	Compliance with the characteristics of children aged 4-6 years	5	100%
3	Correctness of number concepts	5	100%
4	Systematic presentation of material (gradual)	5	100%
5	Suitability of game levels to children's cognitive development	4	80%
6	Completeness of coverage of indicators for understanding number concepts	5	100%
7	Clarity of instructions and game rules	4	80%
8	Potential of media in improving understanding of number concepts	5	100%
Total Score		38	
Eligibility Percentage			95%
Category		**Very Worth It**	

Description: Eligibility Percentage = (Total Score / Maximum Score) × 100% = (38/40) × 100% = 95%

Based on Table 5, the validation results by the first material expert show that the media developed obtained a feasibility percentage of 95%, so it is included in the very feasible category.

Table 6. Media Expert Validation Results (Cucu Susianti, M.Pd)

NO	Assessment Aspects	Score	Percentage
1	Visual design appeal	5	100%
2	Accurate color selection	5	100%
3	Number clarity and legibility	5	100%
4	Media size appropriate to the user	5	100%
5	Media safety for children (rounded corners, non-toxic materials)	5	100%
6	Media durability and longevity	4	80%
7	Illustration quality	5	100%
8	Ease of use and storage	5	100%
9	Design consistency between cards	5	100%
10	Media component completeness (cards, box, manual	5	100%
Total Score		49	
Eligibility Percentage			98%
Category		**Very Worth It**	

Based on Table 6, the validation results by media experts show that the media developed obtained a feasibility percentage of 9%, so it is included in the very feasible category.

Table 7. Media Expert Validation Results / Early Childhood Education Practitioner (Cucun Yunianingsih, M.Pd)

NO	Assessment Aspects	Score	Percentage
1	Alignment with basic competencies and PAUD indicators	5	100%
2	Relevance of material to learning needs in the field	5	100%
3	Ease of use by teachers	5	100%
4	Suitability to classroom learning contexts	5	100%
5	Media appeal to children	5	100%
6	Time efficiency in learning	4	80%
7	Flexibility of use for various activities	5	100%
8	Clarity of teacher guidebooks	5	100%
9	Potential for increasing children's social interactions	5	100%
10	Suitability to children's cognitive development stages	5	100%
Total Score		49	
Eligibility Percentage			98%
Category		**Very Worth It**	

Based on Table 7, the validation results from material expert 2, who is also an early childhood education practitioner, obtained a feasibility percentage of 98% with a total score of 49 out of a maximum score of 50, which is included in the very feasibility category. This very high assessment reflects the practitioner's perspective, which assesses media not only from a theoretical perspective but also from an implementability and practical perspective.

Table 8. Summary of Expert Validation Results

NO	Assessment Aspects	Score	Percentage
1	Material Expert 1 (Dr. Dede Supendi, M.Pd)	95%	**Very Worth It**
2	Members of the Media (Cucu Susianti, M.Pd)	98%	**Very Worth It**
3	Material Expert 2 / Early Childhood Education Practitioner (Cucun Yunianingsih, M.Pd)	98%	**Very Worth It**
AVERAGE		97.00%	**Very Worth It**

Based on the summary table of expert validation results, the Domino Ceria media obtained an average feasibility percentage of 97.00%. The assessments from the three validators showed percentages of 95%, 98%, and 98%, respectively, so that overall the media was included in the very feasible category. After theoretical validation by experts, empirical validation was carried out

through a limited trial on 10 children (5 children in Group A and 5 children in Group B) for two meetings to assess the readability, ease of use, and appeal of the media through observations by researchers and teachers.

Table 9. Limited Trial Results

NO	Observation Aspect	Group A (n=5)	Group B (n=5)	Average
1	Children are attracted to the visual design of the media.	100%	100%	100%
2	Children can read numbers clearly.	80%	100%	90%
3	Children can hold and manipulate cards easily.	100%	100%	100%
4	Children understand the rules of the game after they are explained.	60%	80%	70%
5	Children are enthusiastic about playing with the media.	100%	100%	100%
6	Children can complete level 1 of the game.	80%	100%	90%
7	Children want to play again after finishing.	100%	100%	100%
Overall Average		88.57%	97.14%	92.86%

A limited trial of 10 children showed that the Domino Ceria media achieved an average score of 92.86%. Children showed a high level of interest in the media's visual design from the moment it was first introduced. Number legibility was good, although a small number of children in Group A still needed assistance distinguishing some number symbols. All children could easily hold and manipulate the cards during the game. Most children were also able to understand the game rules after teacher explanations, although younger children required assistance. Furthermore, the children showed enthusiasm during the activity, were able to complete the Level 1 game, and expressed a desire to play again after the activity was completed.

The effectiveness of the Domino Ceria media in improving the understanding of number concepts in children aged 4–6 years was measured using a pre-test and post-test design. The trial was conducted with 40 children at Trisula Perwari Kindergarten in Purwakarta Regency, consisting of 15 children in Group A (aged 4–5 years) and 25 children in Group B (aged 5–6 years). Implementation of the media took place over eight sessions, each lasting 30–45 minutes. A pre-test was conducted individually to measure children's initial ability to understand number concepts before the media was implemented. The test included five indicators: recognizing number symbols 1–10, relating number symbols to the number of objects, ordering numbers 1–10, performing simple addition, and performing simple subtraction.

Table 10. Pre-Test Results of Understanding Number Concepts

NO	Indicator	Group A (n=15)	Group B (n=15)	Average
1	Recognizing number symbols 1-10	1.87	2.56	2.30
2	Relating number symbols to the number of objects	1.33	1.92	1.70
3	Ordering numbers 1-10	1.07	1.76	1.50
4	Performing simple addition (result ≤10)	0.80	1.44	1.20
5	Performing simple subtraction (result ≥0)	0.53	1.12	0.90
Rata-rata		1.12	1.76	1.52
Percentage		28.00%	44.00%	38.00%
Category		Not Yet Developed	Starting to Develop	Starting to Develop

The pre-test results showed that the average score of Group A was 1.12 (28.00%) with the category of Not Yet Developing, while Group B obtained an average of 1.76 (44.00%) with the category of Starting to Develop. The overall average of children's initial abilities was 1.52 (38.00%) with the category of Starting to Develop. Domino Ceria media was implemented during 8 meetings in small group learning activities. Children were divided into several groups consisting of 4–5 children and played using a set of Domino Ceria cards in each group. Learning began with an introduction to the media, followed by a demonstration of how to play by the researcher, then the children played in turns with the guidance of the teacher and researcher.

Figure 2: Photo of Doria's activities

The post-test was conducted one week after the last implementation with the same procedures and instruments as the pre-test to maintain measurement consistency.

Table 11. Post-Test Results of Understanding Number Concepts

NO	Indicator	Group A (n=15)	Group B (n=15)	Average
1	Recognizing number symbols 1-10	3.27	3.72	2.30
2	Relating number symbols to the number of objects	3.00	3.52	1.70
3	Ordering numbers 1-10	2.80	3.36	1.50
4	Performing simple addition (result ≤10)	2.67	3.24	1.20
5	Performing simple subtraction (result ≥0)	2.40	3.00	0.90
Average		1.12	2.83	3.37
Percentage		28.00%	70.75%	84.25%
Category		Not Yet Developed	Developing According to Expectations	Developing Very Well

The post-test results in Table 11 show an increase in children's understanding of number concepts. The overall average score increased from 1.52 (38.00%) in the pre-test to 3.17 (79.25%) in the post-test. Group A obtained an average of 2.83 (70.75%) with the category of Developing According to Expectations, while Group B obtained an average of 3.37 (84.25%) with the category of Developing Very Well. Analysis of the improvement was carried out by calculating the gain score between the pre-test and post-test results for each indicator.

Table 11. Post-Test Results of Understanding Number Concepts

NO	Indicator	Pre-test	Post-test	Gain	Improvement (%)	Category
1	Recognizing number symbols 1-10	2.30	3.55	1.25	54.35%	Significant
2	Connecting number symbols with the number of objects	1.70	3.33	1.63	95.88%	Significant
3	Ordering numbers 1-10	1.50	3.15	1.65	110.00%	Significant
4	Performing simple addition	1.20	3.03	1.83	152.50%	Significant
5	Performing simple subtraction	0.90	2.78	1.88	208.89%	Significant
Average		1.52	3.17	1.65	108.55%	Signifikan

The analysis results showed that all indicators improved. The average score increased from 1.52 in the pre-test to 3.17 in the post-test, representing a gain of 1.65, or an average increase of 108.55%.

DISCUSSION

Interpretation of Findings

The results of this study indicate that the Domino Ceria (DORIA) learning media, developed using the ADDIE model, met the feasibility criteria with an expert validation score of 97.00% (very feasible category) and proved effective in improving the number concept understanding of children aged 4–6 years. The results showed an average improvement of 108.55% from pre-test to post-test, indicating a significant increase in children's early mathematical abilities. These findings suggest that the use of game-based learning media can effectively support early mathematics learning in early childhood education settings.

The improvement in children's abilities, particularly in mathematical operations such as addition and subtraction, aligns with Piaget's cognitive development theory, which states that children in the preoperational stage learn most effectively through the manipulation of concrete objects and direct experiences (Piaget, 1952; Wadsworth, 2004). The Domino Ceria learning media provides manipulable game cards and visual representations that help children connect abstract number concepts with concrete experiences. This finding is also consistent with the concrete–representational–abstract (CRA) progression approach in mathematics learning, which emphasizes the importance of using concrete objects before introducing abstract symbols (Clements & Sarama, 2014).

Relationship to Literature

The effectiveness of Domino Ceria can also be explained through Vygotsky's Zone of Proximal Development (ZPD), which emphasizes the importance of scaffolding in the learning process (Vygotsky, 1978). The gradual design of the game allows children to engage in learning activities that are slightly beyond their current abilities with the assistance of teachers and peers. The improvement observed across both age groups suggests that learning supported by social interaction and guided assistance can facilitate optimal cognitive development in early childhood. This result is consistent with research by Bjorklund (2005) regarding the importance of guided participation in children's cognitive development, as well as the findings of Bodrova and Leong (2007), which demonstrate that play-based learning accompanied by appropriate scaffolding can significantly enhance young children's cognitive abilities.

Furthermore, the findings of this study support the concept of game-based learning, which suggests that games serve as an effective learning medium for young children (Hirsh-Pasek et al., 2009; Weisberg et al., 2013). Game elements such as turn-taking, goal achievement, and social interaction can increase children's intrinsic motivation to learn. These results are consistent with the study conducted by Ramani and Siegler (2008), which found that number-based board games can improve children's numerical understanding. The present study extends these findings by demonstrating that matching-based games such as dominoes can also effectively support children's understanding of multiple aspects of number concepts in an integrated manner.

The significant improvement observed in the subtraction indicator indicates that the Domino Ceria media can help children understand mathematical concepts that are

relatively more abstract. Subtraction is generally considered more difficult to understand than addition because it involves the concept of decreasing quantity or loss (Nunes & Bryant, 1996; Carpenter et al., 1999). Through visual representations and the manipulation of game cards, children are able to directly observe changes in quantity, making the concept of subtraction easier to understand. These findings support the work of Fuson (1992), which demonstrates that manipulating concrete objects can enhance children's understanding of mathematical operations, as well as research by Baroody and Lai (2022) emphasizing the importance of understanding part–part–whole relationships in early mathematics learning.

In addition, the improvement in the indicator of connecting number symbols with the quantity of objects reflects the development of children's understanding of the principle of cardinality, which states that the last number counted represents the total quantity of objects (Gelman & Gallistel, 1978). This ability is a fundamental component of early mathematical competence and has been identified as a predictor of later mathematical achievement (Aunola et al., 2004; Jordan et al., 2009). Similarly, improvements in the ability to arrange numbers sequentially indicate the development of children's understanding of ordinality and the mental number line representation, both of which play a crucial role in early mathematics learning.

Limitations of the Study

Despite the promising findings, this study has several limitations. First, the research was conducted in a single early childhood education institution with a relatively limited number of participants, which may limit the generalizability of the findings. Second, the duration of the implementation was relatively short, which may not fully capture the long-term impact of the Domino Ceria learning media on children's mathematical development. Third, the study focused primarily on number concept understanding, while other aspects of early mathematical skills, such as problem-solving and reasoning, were not extensively explored.

Implications

The findings of this study provide several implications for both educational practice and future research. Practically, the Domino Ceria learning media can serve as an innovative and effective instructional tool for early childhood educators to support the development of number concept understanding through play-based learning activities. The media can also encourage children's engagement, motivation, and active participation in mathematics learning.

For future research, further studies are recommended to involve larger and more diverse samples across different early childhood education settings in order to strengthen the generalizability of the findings. Additionally, future research could explore the use of Domino Ceria learning media to develop other aspects of early mathematical skills, such as mathematical reasoning, problem-solving abilities, and numerical literacy.

Overall, the findings demonstrate that Domino Ceria learning media provides an effective play-based learning approach that integrates concrete manipulation, visual

representation, and social interaction to support early childhood number concept development.

CONCLUSION

Based on the results of this study, it can be concluded that the development of Domino Ceria learning media is necessary as a concrete and engaging instructional medium that aligns with the cognitive developmental characteristics of children aged 4–6 years. The media was proven to be feasible for use in learning activities and effective in improving children's understanding of number concepts at Trisula Perwari Kindergarten, Purwakarta Regency.

This effectiveness is demonstrated by the improvement in children's learning outcomes, which increased from an average pre-test score of 1.52 (38%) categorized as “Beginning to Develop” to an average post-test score of 3.17 (79.25%) categorized as “Developing as Expected.” These findings indicate that the Domino Ceria learning media can significantly support the development of early mathematical understanding in young children through interactive and play-based learning activities.

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