



Mindmatch Game Development to Train Students' Visual Cognitive Skills

Sri Handayani Siregar¹, Ali Daud Hasibuan²

^{1,2} Universitas Islam Negeri Sumatera Utara, Indonesia

Corresponding Author: ✉ handayani303221004@uinsu.ac.id

ABSTRACT

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This study aimed to develop the MindMatch Game as an educational game medium for training elementary school students' visual cognitive abilities and to determine its feasibility and practicality. The study employed a Research and Development (R&D) method using the Four-D (4D) development model, consisting of the Define, Design, Develop, and Disseminate stages; however, the study was limited to the Develop stage. The research subjects consisted of one media expert, one subject-matter expert, one Grade III-C classroom teacher, and 15 Grade III-C students at SDN 101873 Desa Baru. Data were collected through observation, interviews, and questionnaires and were analyzed using descriptive quantitative and qualitative methods. The needs analysis indicated that students' visual cognitive abilities were in the low category, with a percentage of 37.6%, while the need for game-based media reached 92.27%, indicating that such media were highly needed. The MindMatch Game was developed as a picture-card-based educational game consisting of a user guide, main picture cards, choice cards, distractor cards, a timer, and a bottle flip, with five levels of difficulty. The results of media expert validation improved from 60%, categorized as moderately feasible, to 80%, categorized as feasible, following revision, while subject-matter expert validation yielded a score of 80%, categorized as feasible. The practicality test showed a teacher response of 97.5%, categorized as highly practical, and a student response of 69.70%, categorized as practical. Thus, the MindMatch Game was considered feasible and practical as an alternative game-based medium in elementary schools for providing practice in students' memory, recognition, concentration, processing speed, and visual accuracy. However, this study did not establish the effectiveness of the medium in improving visual cognitive abilities because it did not employ a pretest-posttest experimental design or a control group.

Keywords: *Mindmatch Game, Research and Development, Visual Cognition, Visual Discrimination, Visual Memory.*

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INTRODUCTION

Elementary school education is an important stage in the development of students' cognitive abilities because, at this phase, there is rapid growth in the ability to observe, remember, process, and connect various information. One ability that needs attention is visual cognitive skills, which are the ability to recognize, distinguish, remember, match, and interpret information received through sight (Moulaei, Sharifi, Bahaadinbeigy, & Dinari, 2024). That ability plays a role in various learning activities, like recognizing shapes and symbols, finding patterns, connecting objects, understanding pictures, and solving problems (French et al., 2023). Therefore, stimulating visual cognitive abilities from elementary school is important as part of efforts to support the development of students' thinking skills.

The development of technology and digital media provides an opportunity for the education world to offer a more interactive and engaging learning process. One form of innovation that can be utilized is educational games, which not only serve as entertainment but can also be designed to provide learning experiences through challenges, game rules, problem-solving, and feedback (Govender & Moreno, 2021). Using games in learning can boost student engagement because the learning activities are packaged in the form of games that match children's characteristics and interests. Specifically, for training visual cognitive skills, games can use images, colors, shapes, symbols, patterns, and matching activities, giving students the chance to actively develop their ability to observe and process visual information (Mitsea, Drigas, & Skianis, 2023).

However, in the learning process at elementary school, media specifically designed to train visual cognitive skills still need to be developed more innovatively. Learning that is too focused on delivering material and completing tasks can limit students' opportunities to practice observing, remembering, matching, and finding relationships between objects (Wiest, Rosales, Looney, Wong, & Wiest, 2022). This situation shows the importance of learning media that can integrate elements of play with focused cognitive activities. Engaging, simple media that suits the students' developmental level is expected to create a more active learning experience while also stimulating the development of visual cognitive abilities (Ng, Xinyu, Leung, & Chu, 2024).

One alternative medium that can be developed is Mindmatch Game, which is an educational game that involves activities of matching and connecting visual information (Salama & Al-Turjman, 2025). In this game, students can be given various stimuli such as pictures, shapes, colors, patterns, or symbols that they need to observe and match according to certain rules. This activity can encourage students to use their memory, recognize differences and similarities, find patterns, concentrate, and make decisions. By combining elements of play and cognitive exercises, Mindmatch is expected to create a fun learning atmosphere without losing the learning objectives.

Based on that explanation, developing learning media that can train students' visual cognitive abilities has become a relevant necessity in elementary school learning. SDN 101873 Desa Baru served as the research context for developing the Game Mindmatch as an alternative medium that integrates games with visual cognitive activities. This study aimed to produce Game Mindmatch media that fits students' characteristics, is easy to use, engaging, and relevant for training abilities such as observing, remembering, matching, recognizing patterns, and solving visual-based problems. The development of this media is expected to contribute to learning innovation while also providing an alternative for teachers to create more interactive and enjoyable learning activities for students.

Research on the use of educational games to support the cognitive development of elementary school students has been carried out in various forms. (Chalik & Cahyani, 2024),

developing an educational game to improve elementary school students' critical thinking skills and showing that the developed media is feasible and effective to use in learning. (Sulmayanti, Kandau, & Yanti, 2025) Also found that game-based training can support the development of executive functions, such as working memory, inhibition, and cognitive flexibility in elementary school students, while also boosting learning motivation. Meanwhile, Reynaldo, Christian, Hosea, & Gunawan (2021) show that using matching games can improve the learning outcomes of early elementary school students. The findings indicate that educational games have potential in supporting the development of students' cognitive abilities and learning outcomes, but most research still focuses on academic skills, critical thinking, executive functions, or general learning outcomes.

Based on previous research, the research gap in this study lies in the still limited number of media games that are specifically designed to train the visual cognitive abilities of elementary school students through activities that involve matching visual stimuli. A review (Agbo, Oyeler, Suhonen, & Tukiainen, 2023) shows that research on educational games for elementary school students has developed, but there are still limitations in the variety of skills being trained and the evaluation design. Research (Pasqualotto et al., 2022) starts to focus more specifically on visual-spatial skills through digital games, especially object observation, spatial visualization, and mental rotation. However, this approach is different from this study, which focuses on developing the Mindmatch game with a matching mechanism of images, shapes, colors, symbols, and patterns as stimuli to train observation, visual memory, concentration, pattern recognition, and the ability to find matches. So, there's still room for research to create media that is simple, contextual, and explicitly places visual cognitive skills as the main goal of development.

The novelty of this research lies in the development of the Mindmatch Game, which integrates the concept of a matching game with visual cognitive exercises in the context of students at SDN 101873 Desa Baru. Unlike previous studies that used games to improve academic or cognitive abilities in general, Mindmatch is designed with a game mechanism that directly stimulates observing, remembering, comparing, matching, recognizing patterns, and making decisions based on visual information. Another unique aspect is the development of media tailored to the characteristics and needs of students at the target school, so it's not just focused on game technology but also on clear educational goals. Therefore, Mindmatch is expected to be an innovative learning medium that makes a special contribution to developing visual cognitive skills in elementary school students.

METHODS

This research uses the Research and Development (R&D) method aimed at creating an educational product and testing its feasibility and practicality (Sugiyono, 2022). The product developed is the Mindmatch Game, which is a game media designed to help develop the visual cognitive abilities of elementary school students. The development model used is the Four-D (4D) model developed by (Thiagarajan, Semmel, & Semmel, 1974), which includes four stages, namely Define, Design, Develop, and Disseminate. This research is limited to the Develop stage because it focuses on producing a valid and practical product, while the Disseminate stage has not been carried out yet since spreading the product widely is beyond the scope of the study.

The Define stage was carried out through observations, interviews with the class teacher, and distributing questionnaires to students to identify the state of visual cognitive abilities and the need for game-based media. The results of the needs analysis were used to establish five indicators of visual cognitive abilities as the basis for developing the Mindmatch Game, namely visual

memory, visual recognition, visual concentration, visual processing speed, and visual accuracy. The Design stage was done by creating the media design, game mechanisms and rules, five difficulty levels, and research instruments. The Mindmatch game consists of a guidebook, main picture cards, choice or answer cards, distractor cards, a timer, and a bottle flip. Next, the Develop stage is carried out by turning the design into a product, which is then validated by content and media experts. The validation results are used as a basis for revising the product, and after that, the product is trialed on a limited scale with teachers and students to see how practical it is.

The research was carried out at SDN 101873 Desa Baru, Batang Kuis District, Deli Serdang Regency, in the 2025/2026 academic year. The research subjects were determined using a purposive sampling technique, which is the selection of subjects based on considerations that align with the research objectives (Sugiyono, 2022). The subjects consisted of one content expert, one media expert, one third-grade C teacher, and 15 third-grade C students. The selection of students was based on initial observations and interviews that showed a need for media that could help students recognize patterns, shapes, and images, and distinguish visual information more carefully.

The research instruments include observation guidelines, interview guidelines, student needs analysis questionnaires, media needs analysis questionnaires, material expert validation questionnaires, media expert validation questionnaires, teacher response questionnaires, and student response questionnaires. These instruments are used to gather data about the initial conditions, media needs, product feasibility, and product practicality (Arikunto, 2021). Qualitative data obtained through observation, interviews, as well as validator suggestions and comments, are analyzed descriptively and used as the basis for product improvement. Meanwhile, quantitative data obtained from questionnaires are analyzed using percentage techniques with the following formula:

$$P = (F/N) \times 100\%$$

Explanation:

P = percentage of the assessment result,

F = score obtained,

N = maximum score.

The next calculation results are interpreted based on feasibility and practicality criteria as follows.

Table 1. Research Instruments

No.	Instrument	Purpose	Respondent/Data Source
1	Observation Guide	To identify the condition of students' visual cognitive abilities in the field	Researcher
2	Interview Guide	To identify problems and media needs from the teacher's perspective	Grade III-C Classroom Teacher
3	Student Needs Analysis Questionnaire	To determine the condition of students' visual cognitive abilities and their need for learning media	15 students
4	Media Needs Analysis Questionnaire	To determine students' needs regarding the use of game-based media	15 students
5	Subject-Matter Expert Validation Questionnaire	To assess the suitability and feasibility of the content incorporated into the MindMatch Game	Subject-matter expert

No.	Instrument		Purpose	Respondent/Data Source
6	Media Validation Questionnaire	Expert	To assess the feasibility of the media design, appearance, and usability	Media expert
7	Teacher Questionnaire	Response	To determine the practicality of the media from the teacher's perspective	Grade III-C Classroom Teacher
8	Student Questionnaire	Response	To determine the practicality and ease of use of the media	15 students

Table 2. Feasibility and Practicality Criteria

No.	Percentage	Feasibility Criteria	Practicality Criteria
1	81–100%	Highly Feasible	Highly Practical
2	61–80%	Feasible	Practical
3	41–60%	Moderately Feasible	Moderately Practical
4	21–40%	Less Feasible	Less Practical
5	0–20%	Highly Infeasible	Highly Impractical

Based on these stages, the MindMatch Game was systematically developed through needs analysis, design, development, validation, revision, and limited testing. The results of expert validation were used to determine the feasibility of the product, while teacher and student responses were used to assess the practicality of the medium. Thus, the final product is expected to meet the criteria of feasibility and practicality as a game-based medium for supporting the development of elementary school students' visual cognitive abilities (Thiagarajan, Semmel, & Semmel, 1974).

RESULTS AND DISCUSSION

Result

Needs Analysis

The results of the initial observation of Grade III-C students at SDN 101873 Desa Baru indicated that some students still experienced difficulties in recognizing patterns, shapes, symbols, and pictures, as well as distinguishing between objects with highly similar visual characteristics. The learning media available at the school were still predominantly limited to textbooks, whiteboards, and worksheets, while game-based media specifically designed to train visual cognitive abilities were not yet available. The interview results with the Grade III-C homeroom teacher further supported these findings, particularly with regard to visual memory and visual discrimination, which still needed improvement. The use of visual media such as projectors was also limited, occurring approximately twice a week. The teacher responded positively to the proposed development of the MindMatch Game as an alternative learning medium.

The results of the questionnaire assessing students' visual cognitive abilities, administered to 15 students, indicated that their abilities were still at a low level. The questionnaire covered five indicators: visual memory, visual recognition, visual concentration, visual processing speed, and visual accuracy. The overall score was 141 out of a maximum score of 375, equivalent to 37.6%, and was therefore classified as low. The lowest score was obtained for the visual concentration indicator, with a score of 24, while the highest score was obtained for visual processing speed, with a score of 32. These findings indicate that students still require targeted

practice to improve their ability to observe, remember, focus attention, process, and discriminate visual information.

Table 3. Results of the Questionnaire on Students' Visual Cognitive Abilities

Indicator	Score 5	Score 4	Score 3	Score 2	Score 1	Score (F)
Visual Memory	2	0	1	3	9	28
Visual Recognition	1	1	0	5	8	27
Visual Concentration	0	0	0	9	6	24
Visual Processing Speed	2	0	0	9	4	32
Visual Accuracy	2	0	0	7	6	30
Total	7	1	1	33	33	141

In contrast to the questionnaire assessing students' existing abilities, the results of the media needs analysis questionnaire indicated a very high level of demand for learning media. Among the 15 students, the overall score was 346 out of a maximum score of 375, equivalent to 92.27%, and was therefore classified as highly needed. The highest score was obtained for the media needs dimension, whereas the lowest score was obtained for the learner characteristics dimension. The high overall result indicates that students require learning media that are more engaging, interactive, and appropriate to their characteristics. This finding further reinforces the results of the observations and interviews concerning the limited availability of game-based learning media at the school.

Table 4. Results of the Learning Media Needs Analysis Questionnaire

Analysis Dimension	Score 5	Score 4	Score (F)
Media Needs	14	1	74
Learner Characteristics	4	11	64
Media Availability	10	5	70
Learning Motivation	9	6	69
Learning Effectiveness	9	6	69
Total	46	29	346

Overall, the needs analysis revealed a gap between students' existing visual cognitive abilities and their need for appropriate learning media. Students' visual cognitive abilities were classified as low, with a percentage of 37.6%, whereas the need for learning media reached 92.27%, indicating that such media were highly needed. The observation and interview findings further supported this condition, particularly regarding students' difficulties in recognizing patterns, shapes, symbols, and pictures, as well as the limited availability of media that could provide interactive visual practice. Based on these findings, the development of the MindMatch Game has a strong needs-based rationale as a game-based medium designed to provide practice in students' visual memory, recognition, concentration, processing, and accuracy.

MindMatch Game Development

The product developed in this study is called the MindMatch Game (Memory Match), a picture-card-based game medium designed to train students' visual cognitive abilities. The MindMatch Game consists of six main components: (1) a user guide containing the objectives of the game, rules, implementation procedures, and a reflection sheet; (2) main picture cards serving as visual stimuli; (3) choice cards or answer cards used to assess students' ability to recall visual information; (4) distractor cards designed to train students' ability to distinguish visual details and improve visual accuracy; (5) a timer used to regulate observation and response time; and (6) a

bottle flip activity used as an opening activity and to determine the players' turns. These six components are systematically integrated so that the game activities are not merely recreational but also provide stimulation for students' visual memory, recognition, concentration, processing, and accuracy.

The MindMatch Game was developed using the Four-D (4D) model, consisting of the Define, Design, Develop, and Disseminate stages; however, this study was limited to the Develop stage. The game was organized into five progressively increasing difficulty levels, ranging from easily recognizable differences between objects to smaller and more subtle visual differences. The gradual increase in difficulty was intended to provide progressively challenging tasks, allowing students to practice observing and recalling visual information in accordance with the progression of the game. Following media expert validation, two revisions were made to the visual design of the product. The first revision involved adding the institutional logo to the product, while the second involved adding borders to the cards to clarify the boundaries between cards and improve visual readability. These revisions resulted in a more structured and visually clear MindMatch Game that was ready for the limited trial stage.

Product Validation

Product validation was conducted by one media expert and one subject-matter expert. The media expert validation was carried out in two stages because several aspects still required improvement during the first stage. The results of the first-stage media expert validation are presented in Table 5.

Table 5. Results of First-Stage Media Expert Validation

Feasibility Aspect	Percentage	Category
Media Design	60%	Moderately Feasible
Practicality	60%	Moderately Feasible
Graphic Quality	60%	Moderately Feasible
Media Suitability	60%	Moderately Feasible
Usefulness	60%	Moderately Feasible

Based on Table 5, the results of the first-stage media expert validation indicate that all aspects obtained a percentage of 60%, which was categorized as moderately feasible. These results indicate that the MindMatch Game had met some of the criteria for learning media but still required improvement before being subjected to a trial. The validator provided several recommendations, including improving the cover of the user guide, adding images of the media components to the user guide, and including the author's profile. These recommendations were subsequently used as the basis for revising the product. After the revisions were implemented based on the media expert's feedback, the product was revalidated to determine the improvement in its feasibility. The results of the second-stage media expert validation are presented in Table 6.

Table 6. Results of Second-Stage Media Expert Validation

Feasibility Aspect	Percentage	Category
Media Design	80%	Feasible
Practicality	80%	Feasible
Graphic Quality	80%	Feasible
Media Suitability	80%	Feasible
Usefulness	80%	Feasible

Based on Table 6, the results of the second-stage media expert validation show that all aspects obtained a percentage of 80%, categorized as feasible. This result represents an increase of 20 percentage points compared with the first-stage validation, which yielded 60%. The improvement indicates that revisions to the cover, the inclusion of complete images in the user guide, and the addition of the author's profile improved the overall quality of the product based on the media expert's assessment. Accordingly, the MindMatch Game was considered feasible in terms of its media aspects and was eligible to proceed to the limited trial stage. Subsequently, subject-matter expert validation was conducted to assess the suitability of the content and game activities with respect to the objective of developing students' visual cognitive abilities. The results of the subject-matter expert validation are presented in Table 7.

Table 7. Results of Subject-Matter Expert Validation

Feasibility Aspect	Percentage	Category
Content Suitability	80%	Feasible
Content Accuracy	80%	Feasible
Content Presentation	80%	Feasible
Language	80%	Feasible
Content Usefulness	80%	Feasible

Based on Table 7, the subject-matter expert validation results indicate that all aspects obtained a percentage of 80%, categorized as feasible. The assessment covered content suitability, content accuracy, content presentation, language, and the usefulness of the content for Grade III elementary school students. These results indicate that the content and activities incorporated into the MindMatch Game are consistent with the development objectives and can be used to support training in students' visual cognitive abilities. Subject-matter expert validation was conducted in only one stage because the product was considered feasible without requiring substantial revisions; therefore, the 80% score represents the final subject-matter expert validation result. Based on the validation results from the media and subject-matter experts, a summary of the product feasibility results is presented in Table 8.

Table 8. Summary of Product Validation Results

Validator	Validation Stage	Percentage	Category
Media Expert	Before Revision	60%	Moderately Feasible
Media Expert	After Revision	80%	Feasible
Subject-Matter Expert	Final Validation	80%	Feasible

Based on Table 8, the final validation results indicate that the MindMatch Game obtained a score of 80%, categorized as feasible, from the media expert after revision and 80%, also categorized as feasible, from the subject-matter expert. These findings demonstrate that the product meets the feasibility criteria in both media and content aspects. Therefore, the MindMatch Game can be considered feasible for use in a limited trial as a game-based medium developed to train the visual cognitive abilities of Grade III students at SDN 101873 Desa Baru. The difference between the media expert's and subject-matter expert's assessments does not indicate an inconsistency in the product; rather, it reflects evaluations of two distinct dimensions, namely the quality and visual presentation of the medium and the suitability of its substantive content.

Practicality Test

The practicality test of the MindMatch Game was conducted after the product had undergone validation and revision. The limited trial was implemented in the form of a group

guidance service involving teachers and students as product users. Practicality was assessed based on ease of use, clarity of instructions, suitability for students' characteristics, implementation of the game, and the usefulness of the medium in supporting the development of visual cognitive abilities. The teacher's response results are presented in Table 9.

Table 9. Teacher Response Results

No.	Statement	Score
1	The instructions for using the MindMatch Game and the user guide are easy to understand.	5
2	The procedures for using the game are explained clearly and systematically.	5
3	The MindMatch Game meets the needs of elementary school students in developing visual cognitive abilities.	5
4	The MindMatch Game supports the achievement of the objectives of group guidance services.	5
5	The MindMatch Game is appropriate for the developmental characteristics of elementary school students.	5
6	The MindMatch Game can be used to train elementary school students' visual cognitive abilities.	5
7	The MindMatch Game can be implemented within an effective amount of time.	4
8	The MindMatch Game is easy to implement in group guidance activities at school.	5
Total		39

Based on Table 9, the teacher's response yielded a total score of 39 out of a maximum score of 40, resulting in a practicality level of 97.5%, which was categorized as highly practical. Seven of the eight statements received the maximum score of 5, whereas the statement concerning time efficiency received a score of 4. These results indicate that the MindMatch Game is generally easy to understand and implement, appropriate for students' characteristics, and relevant to classroom learning objectives. The score of 4 for the time-efficiency aspect indicates that the duration of the game still needs to be considered and adjusted to the available instructional time so that the game can be implemented optimally.

In addition to the teacher's response, the practicality of the product was also assessed through students' responses after participating in the limited trial. The student response questionnaire consisted of 11 statements concerning interest, visual appearance, ease of use, clarity of instructions, comfort, motivation, and the usefulness of the game in training visual abilities. The student response results are presented in Table 10.

Table 10. Student Response Results

No.	Statement	Score
1	I am interested in using the MindMatch Game.	47
2	I find the appearance of the MindMatch Game attractive.	56
3	I can easily understand how to play the MindMatch Game.	48
4	The instructions for the MindMatch Game are easy to follow.	56
5	The pictures and visual displays are easy to understand.	50
6	The instructions are presented clearly.	53
7	The MindMatch Game helps me improve my visual memory.	52
8	The MindMatch Game helps me pay closer attention to pictures and visual details.	54
9	I feel comfortable while using the MindMatch Game.	52
10	The MindMatch Game makes me more motivated to learn.	55
11	I would like to use the MindMatch Game again.	52
Total		575

Based on Table 10, the responses from the 15 students yielded a total score of 575 out of a maximum score of 825, resulting in a practicality level of 69.70%, which was categorized as practical. These results indicate that the MindMatch Game was well accepted by the students, particularly in terms of its visual appearance and instructions for use. The highest scores were obtained for the statements concerning the attractiveness of the game's appearance and the ease of following its instructions, with each receiving a score of 56. Meanwhile, the lowest score was obtained for the statement concerning students' interest in using the MindMatch Game, with a score of 47.

Although variations were observed across the individual statements, the overall responses indicate positive student perceptions of the MindMatch Game. The medium was perceived as providing an engaging and comfortable game-based experience while helping students practice attending to and remembering visual information. Overall, the teacher and student response results indicate that the MindMatch Game is suitable for use in a limited trial. Based on the student responses, the MindMatch Game achieved a practicality percentage of 69.70%, categorized as practical, indicating that the medium is appropriate for use as a supporting medium in classroom learning activities.

Discussion

The research results show that the development of the MindMatch Game is based on the real needs of students in developing their visual cognitive abilities. During the needs analysis stage, it was found that the visual cognitive ability of third-grade class C students was in the low category, at 37.6%, with the lowest score in the visual concentration aspect. These findings were reinforced by observations showing that students still have difficulty recognizing patterns, shapes, symbols, and images, as well as distinguishing objects with almost similar visual characteristics. This situation indicates that the problems faced by students are not only related to their ability to remember visual information but also their ability to maintain attention, discriminate details, and process visual information accurately.

The findings are relevant to the development of studies on the use of games as a medium to support cognitive abilities. The latest meta-analysis conducted (Ishak, Hasran, & Din, 2023) found a positive relationship between digital games and several cognitive abilities, including memory, spatial skills, visual attention, and cognitive control, even though the overall strength of the relationship is relatively small. These findings provide a basis for the idea that gaming activities can be a form of stimulation that supports certain cognitive aspects, especially when the game mechanics are designed according to the abilities you want to develop. In the context of this study, this principle is reflected in the design of the Mindmatch Game, which doesn't just use gaming as entertainment, but places activities like remembering, observing, matching, distinguishing, and selecting visual information at the core of the gameplay.

The high demand for media, which is 92.27%, further strengthens the relevance of developing the Mindmatch Game. Research results show that students need media that is more engaging, interactive, and suited to their characteristics, while game media specifically used to train visual cognitive skills is not yet available in schools. This condition aligns with the study (Suárez et al., 2024) showing that games have developed as an additional form of learning that could enhance the educational process and student engagement. Therefore, the high demand for media in this study can be understood as a result of the gap between students' need to get more interactive learning experiences and the still limited availability of media.

Furthermore, (Bile, 2022) found that most studies report positive results from using educational games, and students generally have a positive attitude towards games as a learning tool and believe that games can boost motivation to engage in learning activities. However, the studies also emphasize that the success of educational games doesn't just depend on the presence of game elements, but also on how the games are designed and how the activities are integrated into the learning process. These findings support the approach used in the Game Mindmatch study, since the game was developed based on previously identified needs and has a specific goal, which is to provide exercises for students' visual cognitive skills.

From a design perspective, the Mindmatch Game has features that match these needs. The product includes a guidebook, main picture cards, choice cards, distractor cards, a timer, and a bottle flip. The main picture cards serve as visual stimuli; the choice cards are used to test memory, while the distractor cards challenge students to pay attention to details and tell apart similar objects. Using a timer adds a time limit, so students need to process the stimuli more intentionally, and the five difficulty levels allow the challenge to gradually increase. With this structure, the game directly relates to the five indicators used in the research: visual memory, visual recognition, visual concentration, visual processing speed, and visual accuracy.

The use of distractor cards and increasing game difficulty is one of the key features of the Mindmatch Game. Students are not only asked to remember an image, but they also have to choose the right information when given several similar options. This activity gives students a chance to compare visual characteristics and pay attention to details. This is relevant to early research findings that showed visual concentration was the aspect with the lowest score. Therefore, there's a logical connection between the problems identified in the Define stage and the game mechanics developed in the Design stage. The product wasn't made just as a regular card game, but was constructed to provide stimulation for skills that were still found to be weak in students.

Another strength of the product can be seen in the gradual application of five levels of difficulty. The game starts with differences in objects that are relatively easy to recognize and then progresses to smaller and more detailed differences. This gradual approach is important because visual cognitive activities for elementary school students need to be provided at a level of complexity that matches their abilities. (Pasqualotto, Parong, Green, & Bavelier, 2023) It also shows that the characteristics of the game and the types of activities used are aspects that need to be considered when designing educational games, because the form of the game can affect students' experience and learning outcomes. Therefore, increasing levels in Game Mindmatch can be seen as a design strategy to provide challenges progressively, rather than just making the game harder.

From the feasibility aspect, the validation results show that the Mindmatch Game has improved in quality after revisions. The first stage of media expert validation scored 60%, categorized as fairly feasible, then increased to 80%, categorized as feasible in the second stage. Improvements were made based on the validator's input, including the guidebook cover, the completeness of media images, and the inclusion of the author's profile. The results show that the validation and revision process played an important role in refining the product. Meanwhile, content expert validation resulted in 80%, categorized as feasible, so both the media and content aspects have met the criteria to proceed to limited trials.

The findings regarding that validation can also be linked to the research results (Hermansyah, Nurhairunnisah, Ardianti, & Sulindra, 2023). A systematic review of game-based interventions in the context of neuropsychological functions shows that game elements can be

used in activities related to cognitive functions. They analyzed 91 articles and 72 games and showed that game elements need to be considered according to the intervention goals. This supports the principle that educational game designs need to have a clear connection between game mechanics and the skills being targeted. In Game Mindmatch, this connection is seen through card matching, the use of distractors, time limits, and level progression aimed at exercising visual skills.

The practicality test results further strengthen the fact that the product is acceptable to users. Teacher responses reached 97.5% in the very practical category, while student responses reached 69.70% in the practical category. Teachers gave very positive assessments on ease of use, clarity of steps, suitability for student characteristics, and the benefits of the game in supporting the practice of visual cognitive skills. The only aspect that scored lower was time efficiency, so the duration of the game still needs attention during activity implementation. Meanwhile, students gave positive responses regarding appearance, instructions, comfort, motivation, and benefits of the game. The highest scores were on appearance and ease of instructions, while all statements remained within the positive response range.

These results are in line with (Mohammed, Fatemah, & Hassan, 2024), who found that elementary school students generally show a positive attitude toward using educational games and view games as a means that can increase motivation to engage in learning activities. This is also in line with the findings (Okankwu & A-Okujagu, 2025) that game-based learning has potential as an engaging form of supplemental learning for students. In this study, the students' positive responses can be explained through the characteristics of the Game Mindmatch, which combines image stimuli, matching activities, time challenges, distractors, and a game system that allows students to actively participate. Thus, the game provides a learning experience that is different from using textbooks, blackboards, or worksheets, which were more commonly used in schools before.

Even so, the research results need to be interpreted carefully. The 80% for both validations shows that the product meets the feasibility criteria, while 97.5% for teacher responses and 69.70% for student responses indicate that the product can be used in limited trials in a practical category. These results can't be used to conclude that the Mindmatch Game is proven to improve students' visual cognitive abilities, because this study focused on product development up to the Development stage and limited trials, without using a pretest-posttest or control group experimental design. These limitations suggest that further research is needed to test the effectiveness of the Mindmatch Game on students' visual cognitive abilities through a stronger experimental research design. (Dong, Liang, Ding, & Zhang, 2024) Also notes that several studies on educational games still have methodological limitations and recommends further research with more diverse participants as well as stronger experimental designs. In addition, the review (Salama & Al-Turjman, 2025) also shows that matching games have the potential to benefit visual perception, pattern recognition, and attention to detail, which aligns with the aspects trained through Game Mindmatch. Therefore, the claim about Game Mindmatch's effectiveness in boosting visual cognitive skills still needs to be tested further through experimental research with appropriate measurements.

Thus, the main contribution of this research lies in the development of a media that is valid and practical, rather than in proving causal effectiveness. The Mindmatch game successfully connects the real needs of students with a game design that specifically targets the practice of visual cognitive abilities. The low initial ability of students at 37.6% and the high need for media at 92.27% provide an empirical basis for product development, while the validation results and

practicality tests show that the product meets the requirements for use in limited trials. With these characteristics, the game Mindmatch can be positioned as an alternative educational game medium that is contextual for stimulating visual memory, visual recognition, concentration, processing speed, and visual accuracy in elementary school students. Future research can test the effectiveness of the product through stronger experimental designs, involving a larger number of students, and comparing changes in visual cognitive abilities before and after using the game.

CONCLUSION

This study produced the Mindmatch Game as an educational game designed to train the visual cognitive abilities of third-grade students at SDN 101873 Desa Baru. Needs analysis results showed that the students' visual cognitive abilities were in the low category at 37.6%, while the need for media reached 92.27%, categorized as very necessary. The developed product received a media expert validation result of 80%, rated feasible, and a material expert validation result of 80%, also rated feasible. It also showed practicality based on teacher responses at 97.5% and student responses at 69.70%, categorized as practical. Therefore, the Mindmatch Game serves as an alternative game media that can be used to provide exercises for memory, recognition, concentration, processing speed, and visual accuracy. However, this study is still limited to the development stage, with limited trials, a relatively small number of subjects, and it hasn't used a pretest-posttest design or control group, so it cannot yet prove the effectiveness or causal improvement of visual cognitive abilities. Therefore, future research is recommended to test the effectiveness of the Mindmatch Game with a stronger experimental design, involving a more diverse number of participants and schools, and refining the duration, difficulty level, and game variations to obtain stronger evidence on the effectiveness and broader applicability of the media.

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