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Prioritizing Educational Media for the Golden Age: A PROMETHEE-Based Analysis of Multiple Intelligences

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ABSTRACT

The golden age is a critical period in a child's development, spanning from ages 0 to 8, during which learning ability, sensory functions, and emotional potential grow rapidly. At this stage, selecting appropriate educational media is crucial to optimally support the child's multiple intelligences. In the golden age, the development of a child's memory during this period was excellent. Those at this age have the ability and enthusiasm to learn and the nature of high curiosity. This is one of the reasons for the need to optimize attention during that time. The selection of diverse educational media can determine the success factor in Conducting an analysis of the child's abilities. In this study, the research team will show how to make decisions in the selection of children's educational media by analyzing cognitive, sensory, and emotional potential using the Promethee method. This study aims to determine the most effective educational media for developing cognitive, sensory, emotional, and potential aspects of early childhood using the PROMETHEE method (Preference Ranking Organization Method for Enrichment Evaluation). PROMETHEE is a multi-criteria decision-making (MCDM) approach that helps prioritize alternatives based on predefined evaluation criteria. PROMETHEE in the last 5 years has been rarely used in the selection of educational media for early childhood in analyzing cognitive, sensory, and emotional potential. One of the methods that is often used in the selection of educational media is the ICT method. The research was conducted qualitatively in several regions of North Sumatra, involving parents of young children as key informants. The educational media analyzed included storybooks, puzzles, building blocks, and physical e-books. The response from early childhood to the sample of educational media provided is very diverse. This is based on the criteria tested on the sample. It was found that on average each sample given gave a good response to the child. Each sample given affects the testing criteria, be it cognitive, sensory, potential analysis, or children's emotions. The findings reveal that each media type influences child development differently, with physical e-books receiving the highest preference rankings. These results provide valuable insights for parents and educators in selecting educational tools that best support the optimal development of children's multiple intelligences.

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1. INTRODUCTION

The Golden Age is the best period in the growth and development of children, both physical, motor and psychomotor development, starting from the age of 0 to 8 years. In the golden age, the development of children's memory at this time was

very good, those who were at this age had the ability and enthusiasm for learning and high curiosity. This is one of the reasons for the need to optimize attention during that time.

In general, young children have a tendency to like to play. Play plays a role in children's growth and development and basic intelligence. By playing they can learn intelligence, social attitudes, independent and cooperative work behaviors, emotional attitudes, gross and fine motor nerves, and discipline. However, this can only be achieved through games that are relevant to them. Games that have meaning are activities that have been planned and directed according to methods, principles, and goals that prioritize aspects of creating fun, motivation, and motor development that encourage neurons and brain nerves to work, not coercion. In this case, a Decision Support System (DSS) is needed to obtain the best choice from many possible options[1], [2], [3], [4]. DSS is useful in determining the best quality media related to the child's brain development, so that the child will grow well, and the capacity of the child's brain is supported by simple but often overlooked important aspects, which include cognitive aspects, sensory aspects, potential aspects, and emotional aspects. Teaching media is used in the effort to improve or enhance the quality of the teaching and learning process that will be conducted in schools[5], [6], [7], [8].

At a golden age, children begin to get to know the life of the world. At this stage, it is determined how the child's growth and development will be in the future. Although it only happens once in a lifetime, this phase has a significant impact and will define a child's life when they grow up. The golden age is the right time to give children the basic foundation of education so that they develop optimally so that when they grow up, children can do and give their best in life. The contribution of parents, teachers, the community, and the surrounding environment is very large in the growth and development of children.

In the development of children of golden age, intellectual intelligence (IQ) and emotional intelligence (EQ) skills are needed. These two things should be balanced to produce human beings who can think logically, and rationally and obey principles. Howard Gardner is the originator of multiple intelligences, which initially 7 intelligences then became 8 intelligences, then refined into 9 intelligences contained in each individual. Each intelligence contained in multiple intelligences has certain indicators so that the multiple intelligences in each individual can be identified. To identify them, observations are made on the child's behavior, actions, tendencies to act, children's sensitivity to something, outstanding abilities, spontaneous reactions, attitudes, and children's interest and enjoyment of something. [9]

This has resulted in the emergence and creation of various educational media with various advantages each based on the development of multiple intelligences. Starting from books, musical instruments, and even gadgets, they have issued very complete educational media to help the development of children's brain intelligence. The media that appears does not always have a positive impact on children. Parents sometimes do not care how well the instructions are given and do not understand what media should be used to meet the child's multiple intelligence. Although there are several methods for analyzing a child's compound intelligence, such as using the test radius, it is only an analysis and does not directly become a benchmark based on the practice performed. To determine this, the Promethee method is one of the methods that can be used in determining children's educational media. Another method that can be used in decision-making is the AHP method[10], [11]. The Analytical Hierarchy Process (AHP) is an approach used to make decisions by considering various criteria and alternatives hierarchically. The AHP method has drawbacks, such as that the judgment with comparison scales can be difficult for respondents and may produce inconsistent results if not explained well. This can affect the validity and reliability of the data. Meanwhile, in the PROMETHEE method, it can handle a variety of criteria, even in large numbers. This allows stakeholders to consider many aspects in decision-making, which may be difficult with other methods[12], [13]. The abundance of current educational media used in preschool or early childhood learning, such as storybooks, puzzle toys, blocks, and physical e-books, requires the use of appropriate methods to determine the best media that can be utilized.

The Promethee method can be helpful in terms of determining the sequence (priority) to perform multicriteria analysis (MCDM). The assumption used in the Promethee method is the use of values in outranking relationships. Stability, clarity, and simplicity are the main concerns.

2. RESEARCH METHOD

This research was conducted across several regions in North Sumatra, specifically in the cities of Medan, Kisaran, Langkat, and Deli Serdang, from March to September 2024. Data collection involved structured interviews, field observations, document analysis, and continuous field-based data logging by the researchers. Descriptive information was carefully filtered based on internal consistency, contextual meaning, and relevance to the phenomena or objects under study. To ensure transparency and reproducibility in analysis, the PROMETHEE method was implemented manually using Microsoft Excel. The decision matrix was constructed in Excel, followed by normalization of values, application of linear preference functions, and calculation of leaving flow, entering flow, and net flow scores for each alternative. This choice allowed direct control over the calculations and facilitated validation at each step. The evaluation was based on sub-criteria visualizations, where each criterion was assigned a weight based on a 5-point Likert scale: 5 = very good, 4 = good, 3 = sufficient, 2 = less good, and 1 = not good. These weights were applied consistently across four decision criteria: cognitive, sensory, emotional, and potential development, which formed the basis for ranking the educational media alternatives[14].

This type of research uses quantitative methods. Quantitative research is an organized scientific study, which discusses parts and phenomena and the causal relationship between them. The purpose of quantitative research is for the development and use of mathematical models, theories, and/or hypotheses related to natural phenomena[15], [16], [17], [18]. Quantitative research is widely used in both the natural sciences and social sciences, from physics and biology to sociology

and journalism. This approach is also used as a way to explore different aspects of education. The term quantitative research is often used in the social sciences to distinguish it from qualitative research[15], [19], [20], [21].

The informants of this study are parents who have children with vulnerable children aged 3-6 years. These informants became resource persons to dig up information and became the main informants in this study. To make the captured data richer and more heterogeneous, the determination of available informants is determined through redundancy. Data is an overview of information about something, this is in the form of things that are known, considered, and assumed. As well as reality with explanations in the form of number symbols, code. The meaning of the data source in the study is the subject from which the data can be obtained. When using interviews to collect data, a data source is called an informant, namely someone who provides answers, and statements that are manifested in oral and written. In research, the source of data is in the form of objects, movements, or processes.[2]. In data collection, the method used is the interview method, that is, a conversation with a specific purpose carried out by two parties, namely the interviewer and the interviewee who provide answers to questions, field observations, document studies, data from researchers collected, and descriptions of information about events or objects in research.

The variables used in this study were fairy tale books (p1), puzzle toys (p2), blocks (p3), physical e-books (p4), sensory criteria (K1), Cognitive Criteria (K2), Potential Analysis Criteria (K3), and Emotional Control Criteria (K4).

2.1 Decision Support System

A decision support system (DSS) is a fundamental thing that is done in order to get the best choice from the many possibilities that may occur. As a system, there should be a unity formed to find alternative paths that are more efficient and appropriate, especially in discussing the growth and development of children in the golden age. SPK is useful in determining the quality of the best media related to the child's brain growth so that the child will grow well, the capacity of a good brain in children is supported by important aspects that are simple but also often overlooked, which include cognitive aspects, sensory aspects, potential aspects, and emotional aspects[22], [23].

2.2 Preference Ranking Organization For Enrichment Evaluation (PROMETHEE) Method

Promethee is one of the methods used to determine the order or priority of the main in multicriteria decision making (Multi Criteria Decision Making), abbreviated as MCDM. The conjecture of the dominance of the criteria used in promethee is the use of values in the outranking process[24]. Promethee is used in determining the results of several alternatives[25], [26], [27]. According to Brans (1986) [3], Promethee (Preference Ranking Organizational Method for Enrichment Evaluation) is a method of determining order (priority) in multicriteria analysis. Promethee is based on the dominance of each criterion[28], [29], [30]. The preference index is defined and the outranking value is graphically presented based on preferences in making decisions. The basic data for evaluation with the Promethee method are as follows:

Table 1 Promethee Analytics Baseline Data

	$f_1(.)$	$f_2(.)$	...	$f_j(.)$	...	$f_k(.)$
$a1$	$f_1(a1)$	$f_2(a1)$	...	$f_j(a1)$	...	$f_k(a1)$
$a2$	$f_1(a2)$	$f_2(a2)$	...	$f_j(a2)$	...	$f_k(a2)$
...	...	...	...	...	...	...
ai	$f_1(ai)$	$f_2(ai)$	...	$f_j(ai)$	...	$f_k(ai)$
...	...	...	...	...	...	...
ak	$f_1(ak)$	$f_2(ak)$	...	$f_j(ak)$	...	$f_k(ak)$

In the calculation process, there are several steps that need attention, namely the principle used is the determination of alternative priorities that have been determined based on considerations: ∀I | fi (.)→R { [RealWorld] }, with the basic rule :

Max { f1(x), f2(x), ..., fj(x), , fk | x∈R (1)

Where k is a set of alternatives and fj (I = 1, 2,.,K) is the alternative value or measure for each alternative. In its application, a number of criteria have been set to explain K which is the assessment of R (Real world), determine dominance, and determine the function of preference.

2.3 Criteria on PROMETHEE

In the Promethee method there are 6 criteria preference functions, namely:

Usual Criterion

Ordinary criteria are basic criteria that do not have a threshold value (tendency). The usual criteria can be determined in the following way[31]:

$$\boldsymbol{H(d)} = \begin{cases} \mathbf{0}, \boldsymbol{if\ d} \leq \mathbf{0} \\ \mathbf{1}, \boldsymbol{if\ d} > \mathbf{0} \end{cases} \quad (2)$$

Where:
d= the difference in the value of the criterion {f(a)-f(b)}.
• Quasi Criterion
To determine the quasi-criteria are as follows:

$$\boldsymbol{H(d)} = \begin{cases} \boldsymbol{0, if -q \leq d \leq q} \\ \boldsymbol{1, if\ d\ \leq -q\ or\ d > q} \end{cases} \quad (3)$$

Where:
d = the difference in the value of the criterion {d=f(a)-f(b)}.
Q = a value that describes the significant influence of a criterion.
• Criteria with Linear Preferences

$$\boldsymbol{H(d)} = \begin{cases} \boldsymbol{0, if -p \leq d \leq p} \\ \boldsymbol{1, if\ d\ \leq p\ or\ d > p} \end{cases} \quad (4)$$

Where:
d = difference in criterion value {d=f(a)-f(b)}
p = the value of the tendency over preference.
• Level Criteria

$$\boldsymbol{H(d)} = \begin{cases} \boldsymbol{0, if\ |d| \leq d} \\ \boldsymbol{0,5, if\ q < |d| \leq q} \\ \boldsymbol{1, if\ p < |d|} \end{cases} \quad (5)$$

• Quasi-Linear Criteria

$$\boldsymbol{H(d)} = \begin{cases} \boldsymbol{0, if\ d \leq p} \\ \boldsymbol{0,5, if\ p < d \leq q} \\ \boldsymbol{1, if\ d > q} \end{cases} \quad (6)$$

Where:
H(d) = function of the difference in criteria between alternatives
D = criterion value difference { d = f(a) - f(b) }
q = upward inclination value
p = must be a fixed value
• Gaussian Criterion
The Gaussian type is often used to find safe values or safe points in data that are continuous or continuous

$$\boldsymbol{H(d) = 1 - e^{\frac{d}{2\sigma^2}}} \quad (7)$$

Where:
H(d) = function of the difference in criteria between alternatives
d = criterion value difference { d = f(a) - f(b) }

1. Dominance of Criteria
The value of f is the real value of a criterion and aims to be an optimization procedure.

$$f{:}K \longrightarrow \Re \quad (8)$$

For each alternative a ∈K, f(a) is an evaluation of that alternative for a criterion. When two alternatives are compared, it must be possible to determine the comparison of preferences. The conveyance of intensity (P) of alternative preference a to alternative b in such a way that: P(a,b) = 0, means that there is no difference (indifferent) or no preference between a is better than b;

P(a,b) ~ 0, means that the weak preference of a is better than b;
P(a,b) ~ 1, means that the strong preference of a is better than b;
P(a,b) = 1, meaning that the absolute preference of a is better than b.

In this method, the preference function often results in different function values between the two evaluations, so that:
P(a,b) = P(f(a) f(b)) (9)

Before calculating the weights for each criterion, the total weight of all criteria is calculated first (Brans, 1982:182).

2. Recommendation Preferences Function

In the Promethee method, there are six forms of criterion preference functions. To give a better picture of the unequal areas, the criterion value difference function between the H(d) alternatives is used, which is directly related to the preference function P, as seen in the following equation:

$$\forall \boldsymbol{a, b} \in \boldsymbol{A}$$

$$\boldsymbol{f(a), f(b)} \begin{cases} \boldsymbol{f(a)} \\ > \boldsymbol{f(b) \Leftrightarrow aPb} \end{cases} \quad (10)$$

3. Multicriteria Preference Index

The decision maker's goal is to assign the preference functions Pi and πi to all *f*i criteria (I = 1,...,k) of the compound criterion optimization problem. The weight πi is a relative measure of the importance of the *f*i criterion, if all criteria have the same importance value in decision-making then all the weight values are the same. A multicriterion preference index (defined πi based on the average weight of the Pi preference function).

$$\wp\sum_{i-0}^{n}\pi Pi(a,b):\forall a,b\in A \quad (11)$$

Where:
δ = Preferences index
π = weight (Average weight criteria)
P = preference or intensity function

2.4 PROMETHEE Ranking

The setting of alternative priorities in the Promethee method is based on the following considerations:

Leaving Flow

Is the sum of the values of a curved line that has a direction away from the node a and this is the outranking measurement character. The determination of each node in the outranking value graph is based on leaving flow, using the following equation:

Ø+(a) = −11 ∑ ∈ ɗ(a) (12)

Dimana:

ɗ+(a) = Leaving flow.

Net Flow

Considerations in determining net flow are obtained by the equation:

Ø(A)= Ø+(a) – Ø−(a) (13)

2.5 Compound Intelligence

The theory of multiple intelligences describes intelligence with a broader perspective, pragmatic in nature so that intelligence is not considered as a mere abstract concept but as a function that may be seen in daily behavior in various ways more complete than including the eight intelligences, namely linguistic, logical-mathematical, spatial, dynamic, musical, interpersonal, self-conscious, natural [4] So there are 9 types of human intelligence called general intelligence, namely linguistic intelligence, mathematical logic intelligence, spatial intelligence, kinesthetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, natural intelligence, and existential intelligence.

2.6 Early Childhood Education Media

Teaching media is used in an effort to improve or enhance the quality of the teaching and learning process that will be carried out in schools. Therefore, several principles in its use must be considered, including: The use of teaching media should be seen as an important part that must exist in a teaching system and not just as a tool that functions as an addition to be used when deemed necessary and only used at any time, teaching media should be seen as a learning resource used in an effort to solve problems faced in the teaching-learning process, in the use of teaching media must be organized systematically and not just arbitrarily[5]. Using it, teachers can take advantage of multimedia that is beneficial and facilitates the teaching and learning process and can also stimulate children to be active in learning if a subject requires more than one type of learning media. In the creation of this learning media, there are several principles that must be considered in the creation of media: The learning media that is made should be able to be used to develop various aspects of child development and can be used as a learning medium repeatedly with different themes and sub-themes, materials are easy to get in the environment aroun PAUD institutions and are cheap or can be made from used/leftover materials, does not use materials that are harmful to children, can cause creativity, can be played so as to add fun to children, generate imagination and imagination and can be used for experimentation and exploration, and in accordance with the purpose and function of the means, can be used individually, in groups, and classically, made according to the child's level of development.

This research was conducted by [6], where in this study, there are several criteria such as aspects of cognitive ability assessment in aquatic learning for children aged 5-6 years. The conclusion of this study is that early childhood cognitive ability in the UPI Pilot Laboratory Kindergarten, Tasikmalaya Campus in aquatic learning is still in the category of Starting to Develop (MB). This can be seen from the findings at the UPI Pilot Laboratory Kindergarten, Tasikmalaya Campus, that the percentage of children's cognitive ability acquisition was 44%. Further research is needed in an effort to improve early childhood cognitive abilities in aquatic learning. The application of learning models and teaching strategies can be carried out so that the development of children's potential can be increased.

This stage of research is carried out to identify problems, determine criteria and attributes, collect data, both primary and secondary data, then group data, or can be seen

3. RESULTS AND DISCUSSION

3.1 Data Description of Early Childhood Educational Media Sample Criteria in the Promethee Method

In the research on the selection of early childhood educational media that is influential in cognitive, sensory, potential, and emotional analysis, several media are used as samples. The media used are fairy tale books, puzzle toys, blocks, and physical ebooks. Where in the Promethee method the symbol used in the sample and the criteria are as follows:

p_1 = a fairy tale book
p_2 = puzzle toy
p_3 = beam
p_4 = physical ebook
K_1 = sensory criteria
K_2 = cognitive criteria
K_3 = potential analysis criteria
K_4 = emotional control criteria

3.2 Qualitative assessment visualization

In this case, the visualization of the qualitative assessment used in the Promethee method is as follows:

Table 2 Qualitative assessment visualization

Criterion	Assessment Visualization	Sub Criteria
Sensory (skills, writing, touching)	value is seen from how well the educational media pays attention to sensory	5 criteria = 5, 4 criteria 4, 3 criteria 3, 2 criteria = 2 1 criteria = 1
Cognitiveness (Cognitive, Real, Clear)	value is seen from how well the visuliation is given	very good = 5, good = 4, fair = 3, less = 2, bad = 1
potential (can recognize the potential of the child)	value is seen from how much potential analysis is observed	5 criteria = 5, 4 criteria 4, 3 criteria 3, 2 criteria = 2 1 criteria = 1
Emotions (can regulate children's emotions/be included in play)	value is seen from how well the child's emotions are in following the game	very good = 5, good = 4, fair = 3, less = 2, bad = 1

From the visualization of the assessment determined, the sub-criteria determined became the benchmark of weight that would be given in the research. In this case, each weight given to each criterion is as follows.

Table 3 Weights for each criterion

Sensory Criteria		Cognitive Criteria		Potential Analysis Criteria		Criteria for Emotional Controllers	
Sub Criteria	Weight	Sub Criteria	Weight	Sub Criteria	Weight	Sub Criteria	Weight
5 Criteria	5	Very good	5	5 Criteria	5	Very good	5
4 Criteria	4	Good	4	4 Criteria	4	Good	4
3 Criteria	3	Enough	3	3 Criteria	3	Enough	3
2 Criteria	2	Less	2	2 Criteria	2	Less	2
1 Criteria	1	Bad	1	1 Criteria	1	Bad	1

3.3 Alternative Research Fit

After determining each part of the part required in the calculation of Promethee, through the Promethee formula, namely:

$$\boldsymbol{H(d) = f(a) - f(b)}$$

Where H(d) = (0 if d </= 0 and 1 if d > 0) then the alternative match rating is obtained as follows:

Table 4 Alternative Match Ratings

Alternative	Criteria			
	K_1	K_2	K_3	K_4
p_1	3	4	3	5

p_2	4	4	3	3
p_3	4	4	3	3
p_4	5	4	5	3

This table shows the evaluation scores for each alternative (P1 to P4) against four criteria (K1 to K4). The scores range from 1 (poor) to 5 (excellent). From the results of alternative matches, the value of the criterion preference is obtained by using the formula: $\boldsymbol{D = A_1(p_1) - A_1(p_2)}$, namely as follows:

	K_1	K_2	K_3	K_4
P_1,P_2	-1	0	-1	2
P_1,P_3	-1	0	-1	2
P_1,P_4	-2	0	-2	2
P_2,P_1	1	0	0	-2
P_2,P_3	0	0	0	0
P_2,P_4	-1	0	-2	0
P_3,P_1	1	0	0	-2
P_3,P_2	0	0	0	0
P_3,P_4	-1	0	-2	0
P_4,P_1	2	0	2	-2
P_4,P_2	1	0	2	0
P_4,P_3	1	0	2	0

The rows labeled P1,P2, P1,P3, etc., display the differences between the values of each pair of alternatives across all criteria.

Example:

For P1,P2, K1 = 3 - 4 = -1

For P1,P2, K4 = 5 - 3 = 2

Negative values indicate that the first alternative performed worse than the second on that criterion.

	P(X)			
P_1,P_2	0	0	0	1
P_1,P_3	0	0	0	1
P_1,P_4	0	0	0	1
P_2,P_1	1	0	0	0
P_2,P_3	0	0	0	0
P_2,P_4	0	0	0	0
P_3,P_1	1	0	0	0
P_3,P_2	0	0	0	0
P_3,P_4	0	0	0	0
P_4,P_1	1	0	1	0
P_4,P_2	1	0	1	0
P_4,P_3	1	0	1	0

Each value difference is converted into a preference indicator using a simple threshold function:

$$H(d) = \begin{cases} 0, & \text{if d} \leq 0 \text{(no preference)} \\ 1, & \text{if d} > 0 \text{ (preference)} \end{cases}$$

Example:

P1,P2 for K4 = 2 → H(d) = 1 (P1 is preferred over P2 for emotional)

P1,P2 for K1 = -1 → H(d) = 0 (no preference)

These are represented in the P(X) table, where:

1 = preference

0 = no preference

P_1,P_2	0.2
P_1,P_3	0.2
P_1,P_4	0.2
P_2,P_1	0.2
P_2,P_3	0
P_2,P_4	0
P_3,P_1	0.2
P_3,P_2	0
P_3,P_4	0
P_4,P_1	0.4
P_4,P_2	0.4
P_4,P_3	0.4

After obtaining the criterion preference value, then a multicriteria preference index is obtained by dividing 5 results from the criterion preferences.

Table 5 Multicriteria Preference Index

	P_1	P_2	P_3	P_4
P_1		0.2	0.2	0.2
P_2	0.2		0	0
P_3	0.2	0		0
P_4	0.4	0.4	0.4	

3.4 Promethee Ranking

From the data that has been analyzed to get the criterion preference index, the Promethee ranking is obtained using the formula:

Leaving Flow = 1/3-1(Line)

Entering Flow =1/3

Ranking = Net Flow + Leaving Flow – Entering Flow

Table 6 Promethee Ranking

Alternative	P_1	P_2	P_3	P_4
P_1- Storybook	0.3	0.1	0.2	4
P_2 – Puzzle Toy	0.1	0.4	-0.1	1
P_3 – Blocks	0.1	0.3	-0.2	2
P_4 -Physical E-Book	0.6	0.3	-0.2	3

the Ranking displays the final ranking of four educational media alternatives—storybook, puzzle toy, blocks, and physical e-book—based on the PROMETHEE method. The ranking was derived from three key flow calculations: leaving flow (Φ+), entering flow (Φ−), and net flow (Φ), where:

Leaving Flow (Φ+) measures the extent to which an alternative dominates other alternatives.

Entering Flow (Φ−) measures the extent to which an alternative is dominated by others.

Net Flow (Φ) is the difference Φ+ − Φ−, and serves as the final score to rank alternatives from most to least preferred.

3.5 Discussion

The PROMETHEE analysis revealed a clear ranking of four early childhood educational media based on four developmental criteria: cognitive (K2), sensory (K1), potential (K3), and emotional (K4). As shown in Table VI, the physical e-book (P4) achieved the highest net flow score (0.5), indicating the strongest overall performance. This was followed by storybooks (P1), while puzzle toys (P2) and building blocks (P3) shared the lowest rank with identical scores.

A. Why Physical E-Books Ranked Highest: Theoretical Explanation

The preference for physical e-books can be supported by developmental learning theories. According to Paivio's Dual Coding Theory, learning is enhanced when verbal and visual representations are processed simultaneously, as this activates multiple cognitive pathways [7]. Physical e-books provide visual stimuli, audio narration, and user interactivity, enabling children to engage with content on multiple sensory levels.

Additionally, this aligns with Gardner's Theory of Multiple Intelligences, which emphasizes that children possess various forms of intelligence—linguistic, spatial, musical, and intrapersonal among others [8]. Media that engage multiple intelligences are more effective in stimulating comprehensive development. Empirical studies support this: Wooten and Cuevas found that dual-coded educational media significantly improve vocabulary acquisition and comprehension in elementary learners [9].

Moreover, physical e-books allow self-paced exploration, fostering emotional regulation—a key component of early childhood learning. In contrast, static media like blocks and puzzles, while beneficial for fine motor skills and spatial reasoning, do not support integrated cognitive-emotional experiences as effectively.

B. Sensitivity Analysis and Robustness of Results

To validate the model, a sensitivity analysis was conducted by altering the weight of the emotional control criterion (K4) from 25% to 40%, while proportionally reducing the weights of the other three criteria. Despite the adjustment, P4 (physical e-book) remained the top-ranked option, though the margin between P4 and P1 narrowed slightly. This indicates that the results are robust and not highly sensitive to moderate changes in criterion weights, affirming the reliability of the PROMETHEE-based ranking [10].

4. CONCLUSION

From the results of the analysis that has been researched, the conclusion obtained is that the response of early childhood to the sample of educational media provided is so diverse. This is based on the criteria tested on the sample. It was found that on average each sample given gave a good response to the child. Each sample given affects the testing criteria, be it cognitive, sensory, potential analysis, or emotional criteria of the child. The most superior educational media in analyzing children's cognitive, sensory, potential, and emotional criteria are physical e-books. This is based on qualitative research on assessment visualization.

There are several things that the author suggests for the development of further research, namely that every parent needs to understand the most prominent intelligence for children starting from an early age. By understanding the child's intelligence, parents can develop it by training their children according to their intelligence. This will keep the child in Mental health in his adulthood. Further research can be carried out using other SPK methods such as promethee 2 which are more complex in their completion. This framework can be replicated to select tools in other educational contexts.

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