Research Article   A. Januantoro and F. Mandita

A Child Growth and Development Evaluation Using Weighted Product Method

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Abstract

Child development is one of the factors that must be considered in improving a country's education. The level of maturity of human resources is able to maximize starting from childhood. The guidebook of the Ministry of Education and Culture of the Republic of Indonesia (Kemendikbud RI) in 2018 contained six indicators to assess children's learning ability, namely: 1) Moral, 2) Social, 3) Language, 4) Cognitive, 5) Motor, and 6) Art. This study implements these indicators to evaluate children's growth and development. The evaluation method uses the Weighted Product Method (WPM). WPM provides a ranking of the result of the evaluation. In addition, WPM also has an assessment of Beneficial and non-beneficial as a more relevant assessment between indicators. Data were collected by questionnaire at kindergarten schools with the respondents' age average of 5-6 years. The results will be calculated with indicators criteria weights given. The test results recommended for students between 0.65 to 0.62 are as follows: Mahmud, Diko, Cindy, Denny, and Riko. The kindergarten manager can use these recommendations to increase the student's aptitude.

Keywords: Decision Support System, DSS, Weighted Product Method, WPM, Child Development.

1. Introduction

Education is one of the main pillars of a nation's establishment. Therefore, an ideal education must be formed from the introduction of learning as early as possible. Education is also directly proportional to the pattern of child growth that can be used as a measure of physical and mental maturity (Lubis, 2020). Education can be formed from parental guidance and upbringing, environment, and also school (Safriyanti & Ibrahim, 2022). There are several levels of education ranging from Early Childhood Education (PAUD) to Higher Education level. This is done to explore the abilities of each individual (Wahyuningsih, 2020). The exploration of individual abilities can be measured from around the age of 5 years. The measurement of individual student abilities can be measured by several indicators in child development that have been regulated by the Ministry of Education and Culture of the Republic of Indonesia (Kemendikbud RI) which include aptitudes in terms of morals, religion, social, language, cognitive, motoric, and also art (Kemendikbud, 2020).

There are several methods that are often used in assessing an object for evaluation in making decisions. Some of the methods that are commonly used, among others: 1) Decision support system to determine children's abilities using Weighted Product (WP) method (Ahsan & Indawati, 2019); 2) The determination of reward using profile matching method (Honggowibowo & Ayuningtyas, 2022); 3) The application of Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method for selecting the best culinary in South Kalimantan, Indonesia (Muin, 2022); 4) The design of learning pattern (Sahroni & Ariff, 2017); 5) The determination of priority of local regulation using Simple Additive Weighting (SAW) (Ihdalhusnayain et al., 2022); 6) The determination of employee performance using WP method (Aminudin et al., 2018); 7) He determination of new student acceptance (Ikrimach & Retnowo, 2022); 8) The evaluation of decision analysis model on top companies in Forbes (Kao et al., 2022); 9) The determination of school

management quality using Multi-Criteria Decision Analysis (MCDM) approach (Afriadi, 2022); 10) The evaluation of faculty on university using Analytical Hierarchy Process) (AHP) method (Moradi, 2022); 11) The evaluation of cost on life cycle in Egypt using AHP method (El Hadidi et al., 2022); and 12) AHP method for general election of president of Indonesia (Rosiska & Harman, 2019).

From several methods that have been studied, this research proposes WPM as evaluation in child growth and development. WPM is chosen because based on research by Fitriasari et al. (2017) and Stanujkic et al. (2023), WPM has weight of beneficial and non-beneficial as evaluation on each existing indicator (Yoni & Mustafidah, 2016). The weight can provide detailed results and can be flexible in some cases. The result of this study will be in the form of recommendations for educators to evaluate students who get the lowest five scores from the assessment list that has been calculated using WP method.

2. Methods

This section provides the explanation of the process of how to process data, as follows:

2.1. Data collection

Table 1
Student list.

Name	Initial
Andi	AD
Agung	AG
Ahsan	AS
Cindy	CD
Dimas	DM
Danny	DN
Diko	DK
Farhan	FH
Ghani	GN
Hasna	HN
Riko	RK
Zendi	ZD

Table 2
Student's aptitude indicator.

Indicator Name
Moral (I1)
Social (I2)
Language (I3)
Cognitive (I4)
Motoric (I5)
Art (I6)

Table 3
Student assessment results.

Student	Indicator					
	I1	I2	I3	I4	I5	I6
AD	3	6	5	3	5	8
AG	8	8	7	5	7	7
AS	7	8	7	5	7	3
CD	8	3	8	8	7	3
DM	5	5	7	6	5	6
DN	8	7	6	5	8	9
DK	7	4	8	8	8	3
FH	7	7	6	6	7	8
GN	5	6	4	5	5	7
HN	5	5	5	5	5	6
JN	8	3	8	8	7	3
MM	7	4	8	9	7	5
RY	8	8	4	3	7	8
RK	6	3	8	9	8	3
ZD	8	8	4	3	7	8

Data collection was carried out using questionnaires, the data was filled in by the teacher of each class. The teacher is given the task of giving grades to students, because the teacher is the closest figure and already knows the character of each student. In this study, the data gathered were of 15 children with assessment results as presented in Table 1.

In Table 1, there are 6 female students and 9 male students. After collecting student data, we determine the indicators used for student growth and development. The indicators used refer to the guidelines of the Ministry of Education and Culture of the Republic of Indonesia in 2007 as presented in Table 2. There are six indicators used to determine student's aptitude. Next step is fill out a questionnaire with the name already mentioned and agreed indicators. The results of student assessment are presented in Table 3.

2.2. Determining the weight of the indicator

Before determining the weight, the first step is to determine the indicator as an assessment material. Then these indicators are given weights according to the level of importance (Khairina et al., 2016). The weight of the indicator is obtained from the results of interviews from schools about the purpose of student evaluation. Weights are subject to change at any time according to the agreement of the school. In this study, the weight of student's aptitude indicators is presented in Table 4.

Table 4

The weight of the student's aptitude indicator.

Indicator	Value
Moral (I1)	3
Social (I2)	2
Language (I3)	5
Cognitive (I4)	6
Motoric (I5)	4
Art (I6)	1

2.3. Calculate the weight values (W)

The determination of the weighted values (W) from six indicators of student's aptitude data is done by using Eq. (1) (Kurniawan & Amanda, 2017),

$$W_j = \frac{w_j}{\Sigma w_j} \qquad (1)$$

where W is the weight of the criterion which is between 0 to 1, where the total of W is 1. It will then be multiplied by 1 for the attribute that is considered as beneficial and multiplied by -1 for the attribute that is non-beneficial. The sampling data is then processed with Eq. (1). The results of determining the weight value can be seen in Table 5. In Table 5, the greatest value is the language indicator and the smallest is the value of the art indicator.

2.4. Determination of normalized values (S)

Table 5

The weight value is obtained from evaluating the value of the normalized weight value (W).

Indicator	Value
Moral (I1)	0.142857143
Social (I2)	0.095238095
Language (I3)	0.238095238
Cognitive (I4)	0.285714286
Motoric (I5)	0.19047619
Art (I6)	0.047619048

Table 6

Normalized value S.

Name	Normalized value of S
Andi	7.654539696
Agung	8.055789877
Ahsan	8.258398132
Cindy	8.410700441
Dimas	8.129799524
Danny	8.261676928
Diko	8.45342936
Farhan	8.277407903
Ghani	7.875286057
Hasna	7.922750317
Jenny	8.410700441
Mahmud	8.504052798
Rayya	7.877482386
Riko	8.455824257
Zendi	7.877482386

The determination of (S) is used to calculate the result of normalized value in each alternative with the result of the indicator's weight. (Wang et al., 2021). Eq. (2) to calculate S is as follows (Sugiarto et al., 2020),

$$S_i = \prod_{j=1}^{n} X_{ij}^{wj} \qquad (2)$$

S_I is the result of normalizing decisions on the alternative-i, and X_{ij} is the rating of alternatives on each attribute, while i is the alternative and j is the attribute. After the weight value of the indicators are calculated, the next step is to normalize the alternative value (Puspitasari et al., 2022) which is calculated by the normalized value of the weight W in Table 6. In Table 6, there are differences from the normalization results where there are five students whose scores are below the average of other students.

2.5. Determination of weight value (V)

Determination of weight value V is the final stage of evaluating child growth and development using WPM. The formula for determining the weight value is shown in Eq. (3),

$$V_i = \frac{\prod_{j=1}^{n} X_{ij}^{wj}}{\prod_{j=1}^{n} x_{ij} + W_j} \qquad (3)$$

where the value of V is the result of the average value of the normalized result of S. The result of the value V is a number which will then be sorted in descending manner from a larger value to a smaller value. The larger value is the optimal value and the smaller value is the non-optimal value (Verma & Patel, 2019).

Table 7
Assessment result V.

Name	V
Andi	0.062524155
Agung	0.065801665
Ahsan	0.067456618
Cindy	0.068700661
Dimas	0.066406194
Danny	0.0674834
Diko	0.069049681
Farhan	0.067611895
Ghani	0.064327265
Hasna	0.064714965
Jenny	0.068700661
Mahmud	0.069463186
Rayya	0.064345205
Riko	0.069069243
Zendi	0.064345205

Table 8
Sorted result of weight values.

Name	V
Agung	0.069924118
Danny	0.069815409
Rayya	0.069650204
Riko	0.069650204
Ahsan	0.069064552
Farhan	0.068983312
Ghani	0.067063076
Andi	0.066965995
Dimas	0.066295955
Hasna	0.066028008
Mahmud	0.065310922
Diko	0.0633041
Cindy	0.06294211
Denny	0.06294211
Riko	0.062059925

3. Results and Discussion

This section explains the results of the evaluation of children's growth and development starting from the process of assessing the weight value of each alternative, normalizing the weight value to determining the best value. The results of the student growth and development evaluation assessment can be seen in Table 7. In Table 7, there are several sets of weighted values for each student. The evaluation is done by sorting the students' weight scores descendingly from the highest to the lowest. The results of sorted student weights is detailed in Table 8. In Table 8, the student Agung have a high level of growth and development evaluation, and student Rico have low scores. In this study, we do not focus on high scores but focused on

low scores. Five low values are selected (Table 8 data in red) which will later be followed up such as mentoring and evaluation to improve their aptitudes.

4. Conclusions

This study resulted in a list of five children who had scores of less than 15 children who were assessed using the WPM. With these results, the WPM can be accepted, because it can produce an assessment of the sequence of students' aptitudes based on indicators from the Ministry of Education and Culture. This study still has shortcomings, namely the value of indicators that have an assessment of cognitive or logical ability only, where it focuses on left-brain abilities. Further research is suggested to combine logical and social skills for more detail in assessment, where it can represent all aptitudes from the left brain for logic and the right brain for social.

5. CRediT Authorship Contribution Statement

Ardy Januantoro: Conceptualization, Methodology, Software, Resources, Data Curation, Writing - Original Draft, Writing - Review & Editing, Supervision, dan Project administration. **Fridy Mandita:** Formal analysis, Investigation, Supervision, Validation, Visualization, Writing - Original Draft, Writing - Review & Editing and Funding acquisition.

6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

7. Acknowledgments

8. Data Availability

Data will be made available on request.

9. Funding

10. Ethical Approval

Ethical approval no patient-identifying parts in this paper were used or known to the authors. Therefore, no ethical approval was requested.

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