**Ability Assessment Competency Standards on**

**Early Childhood with Fuzzy Logic Approach**

**(Case Study on Raudlatul RA Athfal (RA) Bunga Bangsa Parung)**

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Abstract Fuzzy Logic in computer science are widely used to get the value / description of the subjective characteristic (blurred) input. Final scoring or evaluation of children's learning in early childhood education degree is given descriptively not with numbers. The difficulty that arises is the common perception of inequality between teachers and with each other in providing the subjective characteristic assessment. That requires a tool that can minimize the differences that assessment using fuzzy logic approach in determining the variables and parameters in the assessment process for each child. Materials that will be used is 6 aspects assessment in report cards for kindergarten, (ie aspects Moral, emotional and self-reliance, language, cognitive, physical / motor, and art), and then translated into fuzzy logic. It comes in the form of development indicators Not Yet (NY), Starting Appear (SA), Develop According to Expectations (DAE), Developed Very Well (DVW). Then the final results to be obtained is whether the child is ready or not ready to move on to primary education.

Keyword: PAUD, *fuzzy logic,* evaluasi belajar.

**I.1.** **Preliminary**

Early Childhood Education (ECD) is a form of formal education Kindergarten (TK) under the authority of the Ministry of Education and Culture and Raudlatul RA (RA) under the authority of the Ministry of Religious Affairs. Since the year 2010 both MORA and Kemendikbud, giving serious attention to the management of early childhood special which saw the strategic plan for early childhood education which is quite large. It shows no change in the mission of our national education system that turns early childhood contributes greatly to the readiness of the nation's children in running the 9-year compulsory education. The question is, have each manager actually running early childhood learning program standards for early childhood needs for continuing education?

There are two fields in the development of early childhood education are: habituation Development Division (aspects Moral and religious values ​​and aspects of the social, emotional and self-reliance) and Basic Capability Development Division (Speak, cognitive, physical / motor, and art). Calistung is one part of the Basic Capability Development Division, which is the cognitive aspect only (Minister of National Education No. PP. 58 Th. 2009). So the lesson is supposed to only a small part is given to children from a variety of learning in early childhood development. But so far, the cognitive aspects of learning early childhood education remains a priority.

Many aspects that should be given a qualitative assessment of the individual students during their early childhood education based on observations, interviews, administration tasks and performance, sometimes making the teachers need time to be able to give an explanation to each parent / guardian students about the development of children's ability of competence as what he accomplished for the school in early childhood / kindergarten / RA, because the process of assessment is very qualitative and subjective that each teacher could have give different assessments.

**I.2.** **Problem Formulation**

Of the above problems, it can be formulated that, how to do a qualitative assessment of the ability of the standard of competence in early childhood, with data based on observation, administration tasks and performance by using ICT-based approaches, namely the Fuzzy Logic?

**I.3.** **Objective**

As a reference for teachers in the six aspects of learning to be measurable so that progress can be seen in their students.

**II. THE THEORETICAL BASIS**

**2.1. Early Childhood Education**

Early childhood education (ECD) is the level of education prior to primary education, which is a development effort aimed at children from birth to the age of six years through the provision of educational stimulation to assist the growth and development of mind and body so that children have the readiness to enter further education, which was held in formal, non-formal, and informal. [Act No.. 20 of 2003, Chapter 1:14]

Early childhood education level held before the foundation that can be passed through three categories:

1. Formal education Line, which consists of three types of management education, namely: Kindergarten (TK), Raudlatul RA (RA) or other equivalent forms.
2. Line Non-Formal Education, which consists of three types of management education, namely: Play Group (KB), TPA (TPA) or other equivalent forms.
3. Informal education Line, which consists of two types of management education, namely: Family Education or Education organized by the environment.

**2.2. Fuzzy Logic**

         Fuzzy Logic was first introduced by prof. L. A. Zadeh of Barkelay in 1965. Fuzzy Logic is a numerical estimate of a structured and dynamic. This system has the ability to develop a system of intelligence in an uncertain environment. The system is assumed a function with fuzzy logic. In fuzzy logic, there are several processes, namely the determination of fuzzy set, the application of IF-THEN rules and fuzzy inference process.

**2.3. Fuzzy Inference System (FIS)**

         In the use of language is likely to see things that are ambiguity, where it can not be solved by ordinary logic processing. A numerical value can not be expressed exactly (fuzzy values​​) as the value of linguistic 'rather good' or 'very bad'. These values ​​are examples of fuzzy numbers. Fuzzy Inference System is a theoretical concept that can be said to be fuzzy rule-based systems (Fuzzy Rule Based System), Fuzzy Expert Systems (Fuzzy Expert System), Fuzzy models, fuzzy associative memory (Fuzzy Associative Memory), Fuzzy Logic Control (Fuzzy Logic Controller) and Fuzzy Systems.

The basic structure consists of a fuzzy inference system (Jang et al. 1997):

1. Base rule contains a number of fuzzy rules that map the fuzzy input values ​​to the fuzzy output value. This rule is often expressed by IF-THEN format.
2. The database that contains the membership function of the fuzzy set is used as the value for each variable systems
3. fuzzy reasoning mechanisms that perform inference procedure
4. Unit Fuzzyfikasi fuzzifikasi process of the input data firm (crisp) in the following way:
	1. Mapping the value of firm input variables corresponding to the universe of discourse.

- Conversion of data mapped to the corresponding linguistic terms to fuzzy sets have been defined for these variables.

1. Unit defuzzification output mapping of the fuzzy inference to firm value (Widodo 2005).

**III. METHODOLOGY**

Some of the steps being taken in the establishment of fuzzy logic system is as follows:

1. Analysis

Collecting complete data requirements then analyzed and defined needs that must be met by the program to be built. This phase should be done in full to be able to produce a complete design.

1. Establishment of fuzzy set (Fuzzificationi),

at this stage, the input is mapped into a fuzzy set with membership function. In Fuzzificationi stage, it is necessary to determine its parameters and subparameter values, membership functions. From these values​​, will be sought Main parameter values​​.

1. Membership Degrees calculation process



Figure 14 Membership Function Competency Standards ECD

μ [x] = 

 Note: x = the value of the parameter

                     a = minimum value range x

                      b = a and c mean

                      c = maximum value range x

 This statement applies equally to the other parameters using the triangular representation.

1. Query Process

Making Rules, rule-making stage is done using function following implications:

If {(x1 ϵ A1) ₒ (x2 ϵ A2) ₒ....ₒ (xm ϵ Am)} then

 (y1 ϵ B1) ₒ (y2 ϵ B2) ₒ....ₒ (ym ϵ Bm)}

This process is the search criteria for the competence of their students based on the criteria of the desired user with operators AND and OR. In this study, making queries using AND or OR operator to connect between the major parameters. Membership value of the AND operator results obtained by taking the smallest membership value among the elements in the sets are concerned. While the results of the membership value OR operator obtained by taking the largest membership value.

*Operator AND : µAΠB = min (µA[x], µB[y])*

 *min (µ1 and µ2 and µ3 and…µ n)*

*Operator OR : µAUB = max (µA[x], µB[y])*

 *max (µ1 or µ2 or µ3 or…µ n)*

*example:*

*µcompetence language GOOD Π art competence GOOD*

*= min(competence language GOOD (78,60),*

 *art competence GOOD (91,33)*

*= min(0,36 ; 0,37)*

*= 0,36*

1. Inference, this stage is a stage that combines fuzzication stage and the stage of making rules to generate output. This inference stage writer using Mamdani (max-min) can be carried out by the method of Tsukamoto, methods Mamdani and Sugeno method.



1. Defuzzification, the output stage is fuzzy mapping and the resulting output is a fuzzy set of numbers in a domain in a specific range. This process is the process of displaying the query results of search criteria competency standards also result in the form of fuzzy values ​​such as READY or NOT READY

**IV. RESULT and DISCUSSION**

**4.1 Identification and Troubleshooting**

4.1.1 Identification

The scoring system in the form of Learners Progress Report serves to determine the level of moral development and behavior and the development of basic skills, language skills, cognitive, physical / motor, and art. Conducted a qualitative assessment that is, in the report but not in the form of a numeric value in the form of narratives derived from the results of each assessment item development indicators such as: Not Appear (BM), Starting Appears (MM), Growing Hope Under (BSH), Growing It good (BSB). The problem that arises is not worth all the competencies required to expectations by subsequent primary education, for the researcher to identify all the data obtained to finally be judged whether each of the students expressed Already Ready or Not Ready to move on to basic education.

4.1.2 Troubleshooting

Based on the description above, it is necessary to develop a way to make it easier for teachers to support decision making in the assessment of students' skills competency standards, so the end result is known is whether any of the students are ready or not ready to move on to basic education, or used as a reference for teachers to concentrate more stimulus for those who still get assessment comes yet (BM) or Start Appears (MM). The system to be developed using database Mamdani fuzzy models.

**4.2 System Requirements Analysis**

 4.2.1 Input System

In this study, the authors try to build a system Learners Progress Report. These inputs to the system in the form of the following table:

|  |  |  |  |
| --- | --- | --- | --- |
| **NO.** | **DEVELOPMENT PROGRAM** | **NO.** | **PROGRAM DEVELOPMENT** |
|  | **PARA METER** | **SUB PARAMETER** |  | **PARA METER** | **SUB PARAMETER** |
| I | Competence Moral Behavior | 1. Rote prayer daily2. Uttered Toyyibah3. Saying the Adhan and Iqomah4. Know Letter hijaiyah5. Know Some Asmaul Husna6. Rote Short Letter7.Reading the two sentences Creed8. practice prayer | IV  | Cognitive Competency.  | 1.Mention Sequence Numbers2.grouping objects3. Dial-in numbers with the symbol of the concept of numbers4. Know Your Size5. Prepare tile Puzzle6. mixing Colors7. Know the Plant Life Cycle8. Can Use senses according to function |
| II | Basic Competence Islam | 1. Accustomed Utter and answer Regards2. Glad to Be Honest3. Easy to ask and give forgiveness4. Accustomed Reading Benediction before memualai activities5. Responsibility for the task assigned6. Accustomed to thank7. Accustomed to return the toy in its place8. Departing in time for school | V | Competency Physical / motor | 1. Creeping, crawling2. Walking on the board Titian3. Throwing, catching and kicking balls4. variations running5. Interesting line Varies6. Cutting, tearing, sticking and pin7. Folding, tracing8. Shaping the clay / clay / dough flour |
| III | Language Competence | 1. Asked and answered2. Making Simple Sentences3. Imitate back 2 s / d 4 sequence numbers and words (auditory exercises)4. tell5. Retell the story simple6. Citing identity7. Recognizing and Writing letters8. Mention as many names of objects | VI | Competency Art | 1. Free drawing2. rawing in the form of Geometry3. Batik and jumputan4. Finger Painting5.Expression color using crayons, watercolors, etc.6.Moving to the Rhythm Music Free sesaui7. sing8.Creating forms from Building Blocks |

Table 1. Parameters and Sub-Parameters Competence ECD

4.2.2 Output System

Output data information system in the form of assessment of students in the form of a standard capability maturity level of competency that must be possessed by students Fuzzy outputs a value that is: Already Ready and Not Ready

**4.3. Process Design of Fuzzy Systems**

 4.3.1. Fuzzification

In this study, to be conducted fuzzification have 6 variables, which include: Competence moral behavior, competencies basic science of religion, language competence, cognitive competence, physical competence / motor, artistic competence. Each competency has a sub parameters referenced assessment for each of the competencies.

4.3.2. Membership functions

In the membership functions, exemplified for a single variable to be processed by fuzzy approach is as follows:

 a linguistic variable is determined by (X, T, U, M), where:

1. X is a variable Linguistics (example: Language Competence)
2. T = {BSB, BSH, MM, BM}

Where the value of the membership function is as follows

* + Developing Very Good (BSB) [80 100]
	+ Developing As Hope (BSH) [65 85]
	+ Starting Appears (MM) [50 70]
	+ Not Appeared (BM) [10 55]
1. U = [0, 1.0]
2. M connecting BDB, BSH, MM and BM with membership functions as shown in the picture below

MM

BM

BSH

BSB

1

0.9

0.8

0.7

0.6

0.5

0.4

0.3

0.2

0.

1

0

10

22,5

50

55

60

65

70

75

 80

85

 90 100 100 100

**.**

Figure 2. Membership functions for each Competency

Figure 2 is a drawing for the six competencies, because the set of values ​​for each linguistic competence is the same.

 4.3.3. Basis Rule (Rule Base)

In the calculation of data fuzzy rule IF THEN rules. Rules are made based on expert opinion. The number of rules in accordance with the number of variable parameters. In research for the development of students in the diagnosis of RA with 6 competencies that must be answered to determine the results of the acquisition. Prediction capability competency standards have 6 criteria with linguistic variables where each criterion has 4 parameters (membership function) so that the number of rules as much as 46.

This rule is formed according to the characteristics of adaptive training data to be entered. Examples below illustrate two pieces rules.

|  |  |  |
| --- | --- | --- |
| RULE-1 | IF Language Competence BM AND Cognitive Competence BM AND physical / motor competence BM AND Arts Competencies BM | THEN Conditions Competence in Students not ready to move on to Basic Education |
| RULE-2 | IF Language Competence BSB AND Cognitive Competence BSB AND physical / motor competence BSB AND Arts Competencies BSB | THEN Learners condition ready to continue to Dikdas |

Table 2 Base rules

**4.4. Fuzzy Calculations for the Standard of Competence in Students**

 4.4.1. Fuzzification

Parameters, Sub Parameters, the value of each parameter value to get value Main Parameter

Name : Ahmad Kiraam Abqo

No. Parent : A0030910

Grade : B

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NO** |  | **PROGRAM DEVELOPMENT** | **VALUE** | **AVERAGE** |
| I | Sub Parameter Basic Moral Behavior competencies |
|  | 1. | Rote prayer daily | 75 | 79 |
|  | 2. | Uttered Toyyibah | 70 |  |
|  | 3. | Saying the Adhan and Iqomah | 78 |  |
|  | 4. | Know Some Asmaul Husna | 80 |  |
|  | 5. | Know Letter hijaiyah  | 82 |  |
|  | 6. | Letters rote Short  | 80 |  |
|  | 7. | Reading the two sentences Creed | 85 |  |
|  | 8. | Prayer Practice | 80 |  |
| II | Sub Parameter Basic Islam Competence |
|  | 1. | Accustomed Utter and Answer Salam  | 85 | 79 |
|  | 2. | Accustomed Reading Benediction before the start of activities | 80 |  |
|  | 3. | Glad to Be Honest  | 84 |  |
|  | 4. | Easy to ask for and give forgiveness  | 78 |  |
|  | 5. | Responsibility for the task assigned  | 80 |  |
|  | 6. | Accustomed to thank  | 80 |  |
|  | 7. | Accustomed to return the toy in place | 75 |  |
|  | 8. | Departing in time for School  | 70 |  |
| III | Sub parameter Language Competence |
|  | 1. | Asked and answered  | 75 | 77 |
|  | 2. | Making Simple Sentences  | 75 |  |
|  | 3. | Imitate back 2 s / d 4 sequence numbers and words (auditory exercises)  | 80 |  |
|  | 4. | Storytelling | 75 |  |
|  | 5. | Simple retelling the story | 70 |  |
|  | 6. | Citing identity | 78 |  |
|  | 7. | Recognizing and Writing letters  | 80 |  |
|  | 8. | Mention the name of the object as much as | 85 |  |
| IV | Sub Parameter Cognitive Competence |
|  | 1. | Citing Order Numbers  | 90 | 84 |
|  | 2. | Grouping Objects  | 90 |  |
|  | 3. | Dial-in numbers with the symbol of the concept of number  | 85 |  |
|  | 4. | Know the size of  | 85 |  |
|  | 5. | Arrange the puzzle pieces  | 80 |  |
|  | 6. | Mixing Colors  | 80 |  |
|  | 7. | Know the Plant Life Cycle  | 78 |  |
|  | 8. | Can Use senses according to function  | 85 |  |
| V | Sub Parameter Physical / motor Competence |
|  | 1. | Creeping, crawling  | 85 | 71.5 |
|  | 2. | Walking on the bridge board  | 80 |  |
|  | 3. | Throw, catch and kick the ball  | 90 |  |
|  | 4. | Variations walk  | 80 |  |
|  | 5. | Interesting Varied line  | 75 |  |
|  | 6. | Cutting, tearing, sticking and pin  | 80 |  |
|  | 7. | Folding, tracing  | 78 |  |
|  | 8. | Shaping the clay / clay / dough flour 75 |  |  |
| VI | Sub Parameter Art Competency |
|  | 1. | Free drawing  | 75 | 78 |
|  | 2. | Drawing in the form of Geometry  | 78 |  |
|  | 3. | Batik and jumputan  | 75 |  |
|  | 4. | Finger Painting  | 80 |  |
|  | 5. | Expression color using crayons, watercolors, etc.  | 78 |  |
|  | 6. | Moving spaces according to the rhythm of music  | 80 |  |
|  | 7. | Singing  | 82 |  |
|  | 8. | Creating forms of Building Blocks  | 75 |  |
|  |  |  |  |  |

Table 7. Main Parameter value ​​and sub Parameter value

 4.4.2. The calculation of the average value

This process calculates the average value of the main parameters, which results from the sum of the values ​​of the parameters in the input sub then divided by the number of sub parameters.

*PU KAP = (75+70+78+80+82+80+85+80)*

 *8*

 *= 79*

 *PU KID = 79*

 *PU KB = 77*

 *PU KK = 84*

 *PU KFM= 71*

 *PU KS = 78*

4.4.3. The process of calculating the degree of membership

The calculation of the degree of membership, the process is the result of the calculation of the average value of the main parameters using triangular membership functions and shoulders.

1. Moral Behavior Competence: 79

µ (79) =

µ (79) =(79 - 75) / (85 - 75) = 4/10 = 0,4 (BSH)

MM

BM

BSH

BSB

1

0.9

0.8

0.7

0.6

0.5

0.4

0.3

0.2

0.

1

0

10

22,5

50

55

60

65

70

75

 80

85

 90 100 100 100

**0.4**

Figure 3 Membership function for parameters Moral Behavior Competence

1. Basic Islam Competence : 79

µ (79) =(79 - 75) / (85 - 75) = 4/10 = 0,4 (BSH)

1. Language Competence : 77

 µ (77) =(77 - 75) / (85 - 75) = 2/10 = 0,2 (BSH)

1. Cognitive Competence : 84

 µ (84) =(84 – 82.5) / (85 - 80) = 1.5/5 = 0,3 BSH

1. Physical / motor Competence : 71,5

 µ (71,5) =(71,5 - 65) / (75 - 65) = 6,5/10 = 0,65 (BSH)

1. Art Competency : 78

µ (78) =(78 - 75) / (75 - 65) = 3/10 = 0,3 (BSH)

4.4.4. Inference process

In this process, the membership function of how prepared the students to continue further education using trapezoidal membership functions with three linguistic values​​, namely: It Ready, Ready, and Not Ready.

µ

Belum Siap

 Siap

Sangat Siap

1

0.9

0.8

0.7

0.6

0.5

0.4

0.3

0.2

0.

1

0

50

55

80

 85

 100 kesiapan

**0.**

**8**

Figure 4. Trapezoid membership function for readiness

4.4.5. defuzzification

After getting the value of the membership function, then obtained the highest degree of membership of the set of fuzzy linguistic variables. Then calculated by the method of Sugeno (center average defuzzifier) to get the final result if each of the students are ready or not to continue to pursue Basic Education (Primary Education), with reference to the decision rule (according to RA Bunga Bangsa management).

General shape calculations with center average defuzzifier method:

From the results perhitangan membership function of each competency can then result as given in the table below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Main Parameter | Result | BM | MM | BSH | BSB |
| Moral Behavior Competence | 79 | 0 | 0 | 0,4 | 0 |
| Basic Islam Competence | 79 | 0 | 0 | 0,4 | 0 |
| Language Competence | 77 | 0 | 0 | 0,2 | 0 |
| Cognitive Competence | 84 | 0 | 0 | 0,3 | 0,2 |
| Physical / motor Competence | 71,5 | 0 | 0 | 0,65 | 0 |
| Art Competency | 78 | 0 | 0 | 0,3 | 0 |

Table 8 Table Calculation Result of Membership Function

 Readiness = (0,4\*79)+(0,4\*79)+(0,2\*77)+(0,3\*84)+(0,65\*71,5)+(0,3\*78)

 0,4+0,4+0,2+0,3+0,65+0,3

 = 173,675

 2,25

 = 77,2 (masuk kategori SIAP [ 5085 ]

The conclusion of the assessment calculation skills competency standards for students who named Ahmad Kiraam Abqo is READY to continue their education to the next level of basic education.

**V. CONCLUSION AND SUGGESTION**

5.1. Conclusion

Calculation of competency standards for early childhood education using fuzzy logic approach, makes it easy for teachers to provide an objective assessment based on competencies in their assessments because there are rules (rule) applies so that there is uniformity in assessing the ability of the competence of each child in ultimately provide recommendations to the parents / guardians in determining school choice for children who will continue to pursue elementary education with optimal results in the form of sons and daughters conclusion whether they are ready or not ready to learn the next level.

5.2. Suggestion

The scoring system evaluation report on early childhood learning untapped e-learning systems, perhaps because they are not required in early childhood education. But in the future it is expected that early childhood teachers also received training on e-learning, wherein the modules containing the report of the evaluation study mentioned above.

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