

**EARLY MATHEMATICAL ABILITY OF CHILDREN AGED FOUR TO FIVE YEARS IN THE PROVINCE OF BANTEN, INDONESIA**

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**ABSTRACT**

The present research was geared towards studying early mathematical ability of children aged four to five years in the Province of Banten Indonesia. The children's early mathematical ability was measured using a reliable and valid instrument. The instrument was also used to explore teachers' constraints in supporting children to achieve such early mathematical ability. Children aged four to five years early mathematical ability was measured quantitatively focusing on measures of central tendency and dispersion. Results show that children's early mathematical ability have fulfilled the six aspects of early mathematical ability. There are constraints for children aged four to five years to achieve early mathematical ability satisfactorily. One of the constraints faced by children to achieve early mathematical ability is derived from teachers' limited knowledge on early mathematical ability, teachers' conventional methods in learning processes implemented in classrooms, and teachers' minimum knowledge and experience in institutional curriculum development. The implication of current research findings are for the betterment of learning preparation, implementation and evaluation for children aged four to five years in developing early mathematical ability, consideration to take into account data on children low competency for teachers' improvement in understanding curriculum development in order to be productive and creative in the curriculum implementation, and teachers' competency in developing learning activities through creative and educative play by exploring learning resources in the nearby contexts. Teachers should develop pedagogical competency in stimulating children's early mathematical ability in the Province of Banten, Indonesia.

**Keywords:** *Mathematical Ability, Teachers' Knowledge, Curriculum.*

## INTRODUCTION

Mathematical ability in children's early years often becomes a predator for scholastic achievement in the following years. In 2007, Organization for Economic Co-operation and Development (OECD) was concerned about this phenomenon. OECD believed mathematical ability in children's early years is very positive for later development in later years and even in higher education. In December 6, 2005, PISA released the test results of the Indonesian children showing low performances in science, reading and mathematics. Their scores ranked at 62, 61 and 63 out of 69 countries. These test scores are not very much different with the test scores taken in 2012. The above data necessitate serious attention and undertaking from stakeholders in order to solve problems of low mathematical ability. Experts believe that early mathematical ability in children aged three to six years could be used as a basis for mathematical learning processes and outcomes in the future. Therefore, early childhood education should implement effective, research-based and practical curriculum for early mathematical ability enhancement and achievement.

Ideally, learning mathematics should be begun since birth and to be continued when children explore the world around themselves. When children start exploring the world, there should be important figures assisting and supporting them positively and productively. Nearby environment could be used to facilitate mathematical learning. Young children should be given opportunity to listen to use language of math and involve in all activities where math could be possibly experienced. Children's attention should be directed to matters that possibly arouse their attention and interest to think and communicate mathematically with others. Children should grow in environment where learning resources and activities are abundant with mathematical ideas and concepts. Children would play and learning all those mathematical ideas and concepts with high interest, positive attitude and integrative motivation. Mathematical education as early as three to six years old is very important for later learning. Early years children should experience a real life, effective and research-based curriculum by which they could learn and rehearse mathematical knowledge and skill.

Bert and Piaget (1956) stated mathematics is knowledge related to various abstract structures and their inter-relations in such an organized entity. Mathematics is also a deductive thinking paradigm with premises of truth apriorily determined. Reidesel, Schwart & Clement (1992) defined mathematics as scientific thinking media and processes. Many activities could be done through mathematical thinking processes including perceiving, describing, classifying, and explaining patterns every where in number, data and space and even in patterns themselves.

Mathematics play important role in early years children's curriculum. Children aged three, four to five years are on the stage of developing cognitive skills that facilitate them to think and reason with numbers and quantity. Early years children should have frequent access to and interact in activities whereby algebra concepts could be developed, including classification, sorting, comparison, contrast, arranging objects and identifying patterns. Basic geometry is also a part of early years mathematical curriculum including identifying various object forms and communicating direction in space.

Bishop (1988) stated in any culture there are six math general activities, they are: counting, placing, measuring, designing, playin and explaining. NCTM (2000) believed children math knowledge and skills develop since early years. Such math knowledge and skills are developed with high curiosity and spirit through experiencing life directly and naturally. Children should learn and develop mathematical concepts through (a) speaking math language, (b) interacting in math

activities and endeavors, and (c) motivating and being interested in math matters. NCTM hoped such mathematical experience, knowledge and skills could be facilitated in early years children. Mathematical concepts could be introduced to early years children include numbers, geometry, measurement, probability and graphics.

The EYFS expect children to be supported so that they could understand and develop knowledge and skills in problem solving, reasoning, counting in various contexts through exploration, experiencing, learning, practising, speaking their understanding about mathematical concepts. Children should also be given chances to rehearse their skills in order they are able to apply their mathematical knowledge with confidence and self esteem. Environment (including indoor, out-door, and socio-emotional states) play practical and important role in supporting mathematical learning for young children. The EYFS explained that children learn best through effective play and learning. Children need sensitive and supportive assistance from adults. It is widely believed that children will succeed in math when they have good access to and opportunity in exploring mathematical ideas and concepts using common sense. Children will undertake and experience more mathematical endeavors when people around them respect, be interested in, and be sensitive to their smallest contribution.

Various literature conclude early mathematical ability is sensitivity on scientific thinking process in math enacted through number discrimination, arithmetics, one to one correspondence, classification and sorting, patterns, geometry and space, data analysis, probability and problem solving. Mathematical knowledge and skills could be developed in children through understanding and respecting milieu around them which in turn will enrich learning experiences for children. Practises and exposures to new mathematical knowledge should be based on old mathematical knowledge as well.

In general, the present research endeavored to describe and analyze 1) children aged four to five years mathematical ability using reliable and valid measuring instrument in the Province of Banten, Indonesia, 2) mapping problems encountered by children aged four to five years in achieving such early mathematical ability in the Province of Banten, Indonesia. In particular, the research outputs were focused on the following.

1. Description on early mathematical ability of children aged four to five years, based on relevant variables, indicators and domains by means of descriptive statistics, namely central tendency measures and dispersion. Children's early mathematical ability were analyzed for each variable respectively, including numbers, arithmetics, one to one correspondence, classification and sorting, patterns, geometry and space, data analysis, probability and problem solving. Measurement of such variables by administering a reliable and valid instrument,
2. Analysis of problems encountered by children aged four to five years in achieving mathematical ability in the Province of Banten, Indonesia. Encountered children's problems were directed to 1) teachers' knowledge in providing stimuli in order to develop early mathematical ability, 2) early mathematical curriculum including its components, they are: (a) learning goals, (b) learning materials, (c) learning activities and methods, (d) learning resources and media, (e) learning process, outputs and outcomes evaluation.
3. Verification of relevant previous researches in comparison with the present research.

## RESEARCH METHODOLOGY

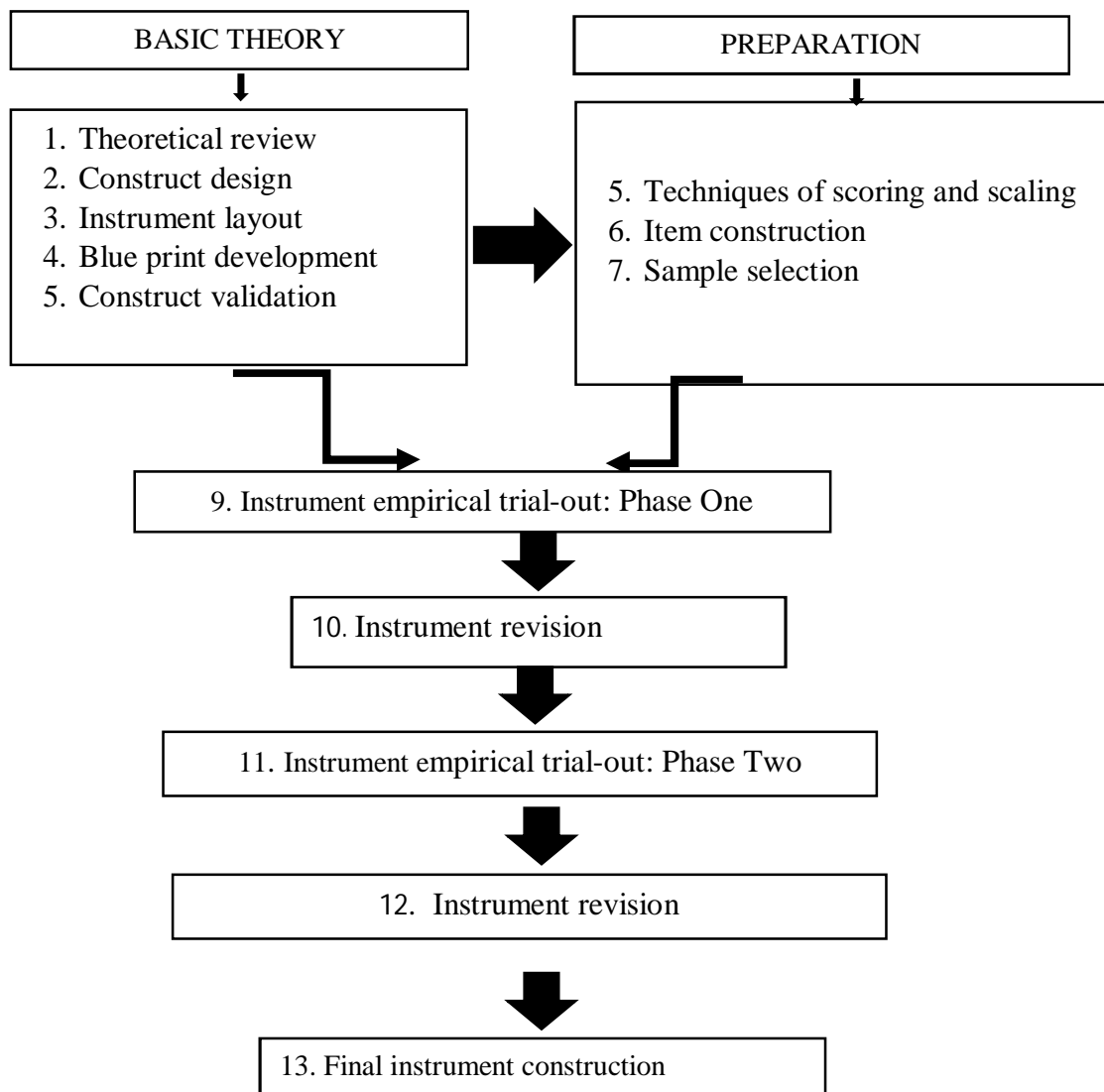
Research methods are basically general procedures or steps undertaken to arrive at the research objectives. Description of early mathematical ability of children aged four to five years in the Province of Banten, Indonesia was completed through basic steps, they are: describing manifest variables of children aged four to five early mathematical ability and indentifying the relevant indicators and domains or learning dimensions based on latest Bloom's Taxonomy of Educational Objectives (Bloom and Krathwol,2009). A test blue print was developed for measuring early mathematical ability of children aged four to five years practially, reliably and validly (Bazeley,2010).

The measuring instrument for children's early mathematical ability in the Province of Banten, Indonesia was calibrated for its precision, standardization, readability, validity and reliability. Its reliability was determined by means of Cronbach Alpha formula. Steps undertaken consisted of data collection, classification, content analysis, data processing, interpretation of results, and conclusion drawing and reporting.

Children aged four to five early mathematical ability were described and analyzed descriptively, focusing on measures of central tendency, namely: mean, median, range, standards deviation, and variance. In the end step, previous relevant studies were reviewed for the present study on children's early mathematical ability in the Province of Banten, Indonesia.

Samples were recruited by implementing a Multistage Proportional Stratified Random Sampling. The instrumen for measuring children's early mathematical ability was developed independently. The instrument was developed using standard theory with the following procedures as follows.

Table 1:  
Instrument development procedures for  
children aged four to five years mathematical ability



Data analysis technique on children’s early mathematical ability applied measures of central tendency and dispersion, particularly the mean, median, mode, range, standard deviation, and variance. The present research was designed using a quantitative research. The research findings were discussed in details using qualitative description, exposition and argumentation.

## RESEARCH FINDINGS AND DISCUSSION

Data analysis results show children's early mathematical ability profile in terms of descriptive statistics in the Province of Banten, Indonesia as the following.

Tabel 2  
Summary of children's early mathematical ability  
in the Province of Banten, Indonesia

Statistics

Aspects	Number	Arithmetics	One to one correspondance	Classification & sorting	Pattern	Geometry	Measuring	Data analysis	Problem Solving
Valid	502	502	502	502	502	502	502	502	502
N Missing	0	0	0	0	0	0	0	0	0
Mean	2.4531	2.4425	2.3322	2.3604	2.2576	2.3145	1.9027	1.0191	.9987
Std. Error of Mean	.02615	.02869	.02863	.02827	.03035	.02818	.01554	.03407	.03390
Median	2.6667	2.7143	2.5000	2.4615	2.3333	2.4444	1.9412	1.0000	1.0000
Mode	3.00	3.00	3.00	3.00	3.00	3.00	2.12	.00	1.00
Std. Deviation	.58597	.64289	.64150	.63345	.68002	.63145	.34815	.76341	.75965
Variance	.343	.413	.412	.401	.462	.399	.121	.583	.577
Range	3.00	3.00	3.00	3.00	3.00	3.00	1.94	3.00	3.00
Minimum	.00	.00	.00	.00	.00	.00	.88	.00	.00
Maximum	3.00	3.00	3.00	3.00	3.00	3.00	2.82	3.00	3.00
Sum	1231.44	1226.14	1170.75	1184.92	1133.33	1161.89	955.18	511.60	501.33

*Source: SPSS Analysis, January 2017*

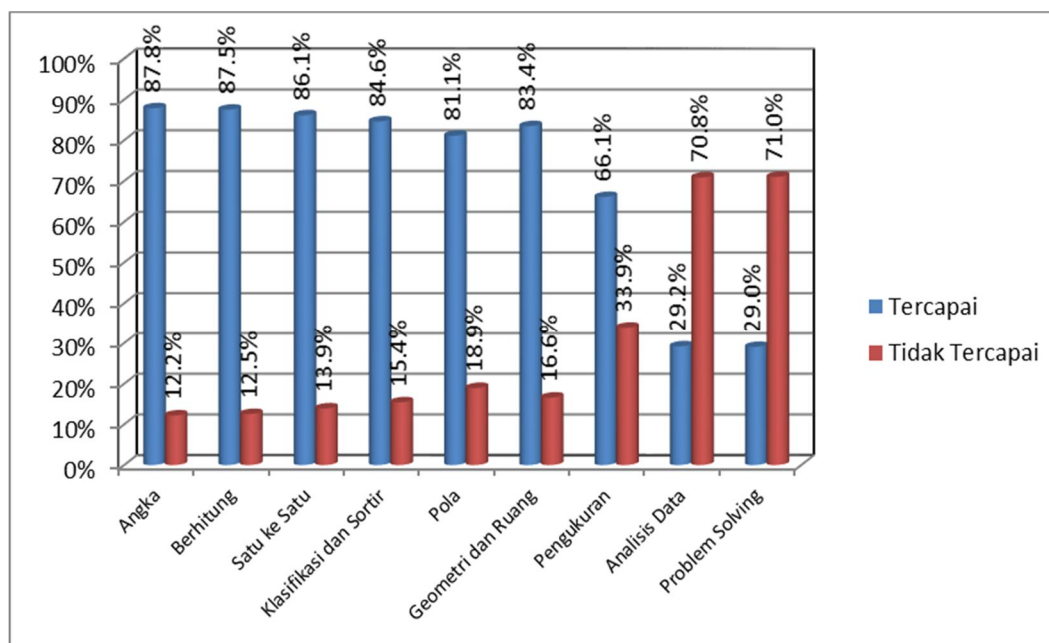
The above table shows profiles of children's early mathematical ability arithmetic means, respectively to aspects in merit order: 1) numbers = 2.45, 2) arithmetics = 2.44, 3) one to one correspondance = 2.33, 4) classification and sorting = 2.36, 5) patterns = 2.26, 6) geometry = 2.31, 7) measuring = 1.90, 8) data analysis = 1.02, and 9) problem solving = 0.10. Three aspects of children's early mathematical ability which are below the grand means, namely: measuring = 1.90, 8) data analysis = 1.02, and 9) problem solving = 0.10 with standard error of measurement all below 1%. The median scores showing 50% of children's early mathematical ability fall below lie at scores of measuring, data analysis and problem solving.

The range shows a difference between the highest and the lowest score. However, the table shows no wide range or variability between the ablest and poorest children's early mathematical ability across aspects of early mathematical ability among children aged four to five years in the Province of Banten, Indonesia. The variances of children's early mathematical ability in 1) numbers = 0.343, 2) arithmetics = 0.343, 3) one to one correspondance = 0.412, 4) classification and sorting = 0.401, 5) patterns = 0.462, 6) geometry = 0.399, 7) measuring = 0.121, 8) data analysis = 0.583, and 9) problem solving = 0.577.

Children's early mathematical ability was measured by means of an achievement test. The score scales range from 0.00 to 100.0, which describes zero achievement and complete achievement of early mathematical ability among children aged four to five years in the Province of Banten,

Indonesia. The minimum mastery of early mathematical ability was set up as high as a mean of 70.00. Children's early mathematical ability in the Province of Banten could be shown in the following graphs.

Tabel 3  
Summary of children's early mathematical ability  
in the Province of Banten, Indonesia  
(in percent)



Source: SPSS Analysis, January 2017

Table 3 show average mastery of aspects of children's early mathematical ability in the Province of Banten, Indonesia. The six aspects of children's early mathematical ability which lie above the minimum mastery indicator of 70.00 could shown as follows: 1) numbers (87.8 %), 2) arithmetics (87.55 %), 3) one to one correspondence (86.10%), 4) classification and sorting (84.60%), 5) patterns (81.10%), 6) geometry and space (83.40%). Therefore, three aspects of children's early mathematical ability which lie below the minimum mastery indicator of 70.00 are as follows: 1) measuring (66.10%), data analysis (29.20%), and 3) problem solving (29.00%).

When results were analyzed in terms of item responses, there are a number of early mathematical ability items were not responded satisfactorily by children aged four to five in the Province of Banten, Indonesia. There are 73 test items in total. However, there were 13 test items were not well responded. Those test items included 1) measuring object lengths (17.80 %), 2) measuring sizes with standard metrics (28.10 %), 3) measuring sizes without standard metrics (31.70%), 4) weighing weight with standard metrics (28.70%), 5) measuring time in hours (31.70%), 6) measuring hot and cold degrees (29.30%), 7) grouping objects (28.70%), 8) sequencing and classifying objects (28.70%), 9) drawing simple graphs of objects (28.50%), 10) summarizing findings about objects (29.70%) , 11) building blocks (30.10%), 12) completing maze (29.10%), and 13) solving daily problems (27.90%). The following table describes in numbers about children's responses to test items.

Tabel 4  
Summary of children's item responses  
in the Province of Banten, Indonesia  
(in percent)

No. Butir	59	60	61	63	65	66	67	68	69	70	71	72	73
N Valid	502	502	502	502	502	502	502	502	502	502	502	502	502
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean	.97	1.07	.96	1.09	.94	1.00	1.00	1.02	1.12	.97	1.08	.98	.93
Mode	0	1	0	1	0	1	1	1	1	0	1	0	0

*Source: SPSS Analysis, January 2017*

Further analysis was conducted on constrains or problems encountered by children aged four to five years in the Province of banten, Indonesia. The analysis was focused on the thirteen test items described earlier. Through focused group discussion, reasons and speculations were explored in details. Children's reasoning and arguments were probed intensively and elaborated through discussion. Through such mechanism, a number of reasons and arguments were documented as follows.

1. Teachers' mathematical knowledge and skills are relatively limited. Children were rarely stimulated on early mathematical aspects, particularly on measuring object lengths, measuring sizes with standard metrics, measuring sizes without standard metrics, weighing weight with standard metrics, measuring time in hours, measuring hot and cold temperature, grouping objects, sequencing and classifying objects, drawing simple graphs of objects, summarizing findings about objects ,building blocks, completing maze, and solving daily problems.
2. Teachers' techniques of developing learning activities were very conventional in the sense that they were very dependent on learning packages or journals which are not discussed and explore early mathematical aspects for early learners.
3. Teachers' understanding and knowledge on curriculum development were relatively limited. Teachers tended not to be productive and creative when notes or notices were not available in the curriculum guidelines.
4. The National Curriculum 2013 for Eraly Childhood Education (EEC) does not specify and explain the early mathematical goals in great details, though these tasks are the responsibility of each institution.
5. The learning goals are not specified, elaborated and explained exhaustively in the curriculum, and this resulted in undetailed and incomplete learning materials for children aged four to six years who effortly learn eraly mathematical concepts and practices.
6. Teachers' current competency is relatively low, especially in developing learning activities through creative and educative play by exploring learning resources in the nearby contexts. Teachers are still showing incompetency in stimulating children's early mathematical ability in the Province of Banten, Indonesia. Teachers' technique in stimulating children's early mathematical ability is more based on work sheets tahn on concepts and application of early mathematical ability of children aged four to five years in the province of Banten, Indonesia.
7. All of the afore-mentioned teachers' weaknesses resulted in incompetency in evaluating learning process quality, outputs as well as outcomes in early mathematical education. Teacher's semantic and episodic knowledge and skills in asesseeing children's early mathematical ability will relatively constrained.



## **CONCLUSION AND DISCUSSION**

The present research could conclude the following factual profiles and constraints of children's early mathematical ability in the province of Banten, Indonesia. Children's early mathematical ability arithmetic means, respectively to aspects in merit order: 1) numbers = 2.45, 2) arithmetics = 2.44, 3) one to one correspondence = 2.33, 4) classification and sorting = 2.36, 5) patterns = 2.26, 6) geometry = 2.31, 7) measuring = 1.90, 8) data analysis = 1.02, and 9) problem solving = 0.10. Three aspects of children's early mathematical ability which are below the grand means, namely: measuring = 1.90, 8) data analysis = 1.02, and 9) problem solving = 0.10 with standard error of measurement all below 1%. The median scores showing 50% of children's early mathematical ability fall below lie at scores of measuring, data analysis and problem solving.

The variability between the ablest and poorest children's early mathematical ability across aspects of early mathematical ability among children aged four to five years in the Province of Banten, Indonesia. The variances of children's early mathematical ability in 1) numbers = 0.343, 2) arithmetics = 0.343, 3) one to one correspondence = 0.412, 4) classification and sorting = 0.401, 5) patterns = 0.462, 6) geometry = 0.399, 7) measuring = 0.121, 8) data analysis = 0.583, and 9) problem solving = 0.577.

The six aspects of children's early mathematical ability which lie above the minimum mastery indicator of 70.00 could shown as follows: 1) numbers (87.8 %), 2) arithmetics (87.55 %), 3) one to one correspondence (86.10%), 4) classification and sorting (84.60%), 5) patterns (81.10%), 6) geometry and space (83.40%). Therefore, three aspects of children's early mathematical ability which lie below the minimum mastery indicator of 70.00 are as follows: 1) measuring (66.10%), data analysis (29.20%), and 3) problem solving (29.00%).

There are constraints encountered by children aged four to five years in achieving early mathematical ability. They are 1) teachers' mathematical knowledge and skills are relatively limited, 2) children were rarely stimulated on early mathematical aspects, 3) teachers' understanding and knowledge on curriculum development were relatively limited, 4) the National Curriculum 2013 for Early Childhood Education (EEC) does not specify and explain the early mathematical goals in great details, though these tasks are the responsibility of each institution, 5) the learning goals are not specified, elaborated and explained exhaustively in the curriculum, 6) teachers' current competency is relatively low, and 7) teachers' weaknesses resulted in incompetency in evaluating learning process quality, outputs as well as outcomes in early mathematical education.

## **IMPLICATION**

The implication of children's early mathematical profiles and constraints could imply to a better learning preparation, implementation and evaluation for children aged four to five years in developing early mathematical ability, especially in children aged four to five years in the province of Banten, Indonesia. In early childhood education, teachers should take into account data on children low competency in three aspects of early mathematical ability, namely measuring, data analysis, and 3) problem solving.

Children constraints in achieving early mathematical ability should be used as positive feedback in stimulating on early children to think and understand mathematical aspects, particularly on measuring object lengths, measuring sizes with and without standard metrics, measuring time in hours, measuring hot and cold temperature, grouping objects, sequencing and classifying objects, drawing simple graphs of objects, summarizing findings about objects, building blocks, completing

maze, and solving daily problems. Teachers' techniques of developing learning activities should be geared towards constructivistic models. Teachers' understanding and knowledge on curriculum development should be improved systematically in order to be productive and creative in the curriculum implementation.

Moreover, teachers' current competency should be improved by all means, especially in developing learning activities through creative and educative play by exploring learning resources in the nearby contexts. Teachers will be more competent in stimulating children's early mathematical ability in the Province of Banten, Indonesia.

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