**TEAHING - LEARNING MATERIAL MODEL OF THREE DIMENSIONAL SHAPES OF GEOMETRY RELATED TO LOCAL CULTURE AT SYUDENTS OF THE ELEMENTARY SCHOOL TEACHER EDUCATION**

P. Sarjiman, Sri Rochadi

Yogyakarta State University

*sarjiman@uny.ac.id*

**Abstract**

 This research aimed to develop ateaching-learning material of three dimensional shapes of geometry and how to carry out the teaching-learning in elementary schools. The material consisted of the concept of three dimensional shapes, width of their surface, and their volumes. The material was for students of the elementary school teacher education.

 This research is a research and development (R&D) by using Plomp Model. The modification carried out of this model was when test, evaluation and revision changed to be validation, tried out and revision. This research was carried out in steps namely: preliminary research, planning, developing and products realization, validation, revision and to be continued with the field tests as an effectivityty test. However, for this time being the process was up to validation and revision. Field tests and effectivity tests will be carried out next year.

 At the beginning, the research result was about the information of the teaching-learning at elementary schools and the elementary school teacher education has not been satisfied, it could be the input of constructing the teaching-learning material. The teaching –learning material design, research instruments, especially the instrument for determining wether the material was valid or not, had also been realized. Looking at the expert validation, showed that the teaching-learning material about three dimensional shapes of geometry, either from the material, prensentaion, language, culture and the completeness of the material point of view, was very good enough. It could be concluded that the material about three dimensional shapes in geometry and its teaching-learning in the elementary schools was eligible and caould be used as a reference in the teaching learning of elementary school teacher education program after field tests were completed.

Key Words: *Teaching-Learning of three dimensional shapes in geometry, Elementary School Teacher Education Students*

1. **INTRODUCTION**

 The development of technology and culture with their aplications need basic knowledge of mathematics for their constructions. Mathematics especially geometry is body knwelege that play in an importan role in the technollogical development. The development of technology and arts runs in line wih the the needs of modern human beings and their culture development. Indonesian young people should be motivated to master the develoment of technology, knowledge and culture and they are of course still the pure Indonesian citizen of Indonesia.

 The importance of mathematics has to be studied by elementary school strudents is that ; (1) they would be able to implemen arithmathics in daily life, (2) mathematics is a means of studying other knowleges; (3) by studying mathematics, counting anything will be easier ; and students will be able think logically, critically and analytically ( Rellers : 2009: 207 ). Where as Fuson & Murray (2011) said that *“ Elementary students should work on developing their ability to create, maintain, and represent mental images of geometrical objects based on their culture”.*

 Learning matery of geometry material studied in the elementary school is aplicative in daily life. In constructing furniture begining from simple to luxurious ones, needs the knowledge of geometry as rectangle, square, triangle, cube, and any other forms of Eucledian geomerty. By mastering elementary school geometry, students will be able to construct natural resources where the elementary students live. By mastering geometry well, students who cannot continue their study, will be ale to manipulate the surrounding natural resources where students stay to be marketed commodity.

The education of Indonesian children should not far from their own local culture. Brion Array (2009: 532) said that : ‘*Good Education have to be based on local culture’.* The ancient society had already used geometry in their daily life as had been said by Travers (2008: 42) as follows:

 *As long ago as 3000 BC, the Syrians used Geometry to build temples, the Early Egyptians used it to compute the amount of grain they could store in a bin of a given size and shape.*

 At that time geometry was very useful practically as for measuring width, volume (Babilonia nation) , and ancient Egyptians used it for building piramides. Van de Vendal (2009:35) presented 5 reasons why geometry ws very important to be learened. *Firstly*, geometry helped people to have fully apreciation about their world, it could be found in solar system, geological formation, herbs and plantation, animals, architectures, arts, and mechanism of machine works. *Secondly*, geometrical exploration could help developing problem solving. *Thirdly*, geometry could help play important role in other fields of mathematics*. Forhtly,* geometry was used by many people in their daily life. *Fiftly*, geometry was interisting and full of challenges. Where as Carl Mark (2009: 53) also stated that : ”*Geometry has applications to many fields, including art, architecture, physics, and other fields of mathematics*”. From that statement showed that many fields need geometry to develop their usefulness. The ability of constructing anything including engineering of indonesian people in the coming generation is also determined by geometry mastery of our elemantary students. Besides, whenever our elementary students used to many forms of geometrical shapes, they would know their envioremnt quickly could develop commodities that could be marketed in their envoiroments or outside areas.

 Considering the importance of geometry mastery, begining from elementary students and its developmet, the writer felt unoptimistic to see that geometry mastery of elementary students was weak . The writer understood this case when he was in the elementary school to be the student practise counselor. Futherly, Rebbeca ( 2012: 7) satated that : *When it comes time to do geometrical activities, several preservice teachers tell stories of how they hate geometry teaching-learning to their students.* Accoding to her, geometry was a difficult mathematics material after word problems and fraction.

 Geometry is one of mathematics materials sudied in the elementary school, beginning from low classes up to hiher classes. This material is a fondation to develop the coming geometry as tranfrmation geometry, space geometry and the like. In the coming development, geometry is applied in the construction houses, hotels, bridges, and any other properties and bulidings. Many kinds of transportations also need geometry in their contructions and managements.

 The Writer’s experiments when he was a lecturer or Elemetary School Teacher Education Programe showed that the main material of Eucledian Geometry had not been mastered well by the students. The method of how to teach planes and three dimensional material in the elementary schools had not been mastered well too, so whenever the students practiced teaching in the elementary schools, the elementary students were confuse. Besides. The teaching-learning material of Geometry about three dimentional shapes especially had not been totally agreed by lecturers, so the material of geometry especially in three dimentioal shapes was different from one lecture to any other lectures.

 Learning material was the material pakaged and to be presented in the teaching-learning process. The content of learning material was mainly knowlegde, value, behaviour and skill which full of message, information, and illustration of facts, conepts, principles and process dealing with certain main problems to get the teaching- learning goals (Crowley, 2014: 37). Learning material could also be meant as a composition of a complete of teaching-learning material which was compsed sistematically, represented a complete full of competense which was going to be mastered by students . Besides, learning material contented also about value, attitudes, behaviour, and full of message, information and information and illustration about facts, concepts, prinsiples and process relating to the certain main disscussion to achieve the lerarning goal. ( Rahmi at all (2013 :2-4) According to *National Centre for Competency Based Training* (Sacramento ,2014)**,** learning material was everything used by teachers or instructors in the process of teaching-learning. The material could be in the written form or not . Other experts said that learning material was a collected material composed sistematically, either in the written forms or unwritten forms, it created an environment or condition to motivate students to study. It could be cocluded that learning material was a collected material compused sistematically, so that it created situaion and environment for students to study. It also appeals a body competence that should be mastered bay students and it is used in planning, actuiting and evaluation of teaching and learning. Learning material that is meant here is learning material about three dimentional shapes in Geometry relating to local culture for elementary schools.

 Learning material model is a material design that is used as a regulation in planning in teaching-learning or tutorials in classrooms. Armando, (2015:17) stated that :” *The term teaching-learning material model ferers to a particullar material approach model to introduction that includes its characteristic, specification and management system.”* Where as Joyce & Weil (2016:27) stated that :” *models of teaching material* are *really models of* *learning material,* a*s we help students achieve information, ideas skills, value, ways of thingking and means of expressing themselves. The material model also offers students how to learn.*

Learning material model is are also a kind of material or a material design which is compossed based on teaching-learning model wished from certain curricullum. According to Joyce & Weil (2016:3*). A model of teaching-learning-material is an instruktional material that is ready to be used in teaching; it was constructed based on the teaching-learning model we desire and also based on certain curriculum.* The result of teaching-learning is also determined by learning material that is used.

 Based on those opinions, what is meant by teaching-learning material model is a conseptual design material used as a learning material regulation in actuating the way, process and action in getting knowledge influencing students how to study , so that the learning material could be mastered. In this case, the learning material model is the learning material of three dimentional shapes of geometry related to local culture.

 The term ‘geometry’ is a branch of mathematics dealing with measurement in many fields.

According to Balmeo (2007: 9), *Geometry from the Ancient Greek (Geo= earth, metron: mesurement) is a branch of mathematics concerned with equations of shape, size, relative positions of figures and the properties of space. A mathematicien who works in the field of geometry is called a geometer. Geometry worked independently in a number of early cultures as a practical way for dealing with lengths, areas and volumes*.

Thus, geometry has already been used in daily life; it deals with form, size, properties, length, width, volume and the like. To study three dimensional shapes of geometry, people usually studying planes first. Three dimensional shapes of geometry in elementary school and at students of elementary school teacher education is an Eucledian Geometry. It comprises the study of dots, lines, planes, angles, congruence, similarity, three dimentional shapes and analitical geometry. Besides, Ecludian Geometry has also aplications in knowlege as computer, christalography, and any othyer branch modern mathematics. Three dimentional shapes of geometry studied in elementary school and elementary school teacher education program is polyhedron; *“ A polyhedron is a three demensional object made up of polygonal region called faces. The sides and vertices of the faces are called edges and verticed of the polyhedron.* (Albert. B. Bennet, Jr,: 2009: 594).

 Culture is the products of human beings’ efforts , creations, how to things and skills.

 Cafarony Ellaform (2008: 17) stated that : “ *Culture is everything created by human beings; it can be in the form of buildings, arts, literature and others.*  Culture could be in the form of buildings inherited by our ancistors, or buildings that would be build in the coming time. Geometry either planes or in the form of dimentional shapes connects tightly with products of culture inherited by our ancistors. Culture influced enough to the education, as has been stated by Embarskein (2015) that “ *Cultural tendencies impact the way children participate in education.”*Culture could influence to beliefif, values and participation to the education. As has been stated by Bennett, (2013) as follows.

*The influence of culture on beliefs about education, the value of education, and participation styles cannot be overestimated. Many Asian students, for example, tend to be quiet in class, and making eye contact with teachers is considered inappropriate for many of these children. In contrast, most European American children are taught to value active classroom discussion and to look teachers directly in the eye to show respect, while their teachers view students' participation as a sign of engagement and competence.*

1. **RESEARCH METHOD**

This research was a research and development. Development meant as a sistematic study for construction design and evaluation progam, process and learning material product that should be valid and effective. Development model used in this research was Plomp model (2001) considering product quality. The procedures of development model used in teacing-learning based on Plomp model that had been modified. The modification carried out about Plomp model, that was test face, evaluation and revision became validation, experiment and revision. Model development of teaching-learning consistied of four faces namely: (1) early investigation fase, (2) planning fase, (3) realisation fase, and (4) validation and revision fase, as well as field test face. However, in this occasion, at the first satage was only from planning, realization, up to validation and revision. The next steps, those were field test and revision were carried out in the next year. The activities carried out of every fase were described as follows.

 The activity at early investigation was gathering information about teaching-learning mathematics problems, especially three dimensional shapes of geomery in elementary schools and lecturing at students of elementary student teacher education programe. After the information considered to be complete, the writer composed rasional thingking about developing three dimensional shapes of geometry relating to local culture at students of elementary shcool teacher education progame. In order to be able to construct learning material about three dimensional shapes of geometry well, the reseacher carried out early investigation about tacheng- learning of mathematics in elementary schools and in elementary school teacher education programe .

 Developing learning material about three dimensional shapes of geometry and its teaching-learning in the elementary schools, the reseacher collected materials from books, magazines, articles, journals, culture photos and any ather resources.Those consturcted material should fullfill the criteria of valid and effective. The development of research instrument mainly in the same time as developing the learning material of three dimensioanl shapes of geometry relating to local culture and its teaching-learning of geometry in elementary schools.

 At the planning fase, the researher plan to solve problems that had been stated in the early investigation. The plan consisted of learning material model of three dimensional shapes of geometry , an image of students condition in oder the three dimensional shapes model of geometry in line with students condition firmly. Besides, it was necessary to plan the effects of the application of the mathod used in teaching learning. In this fase, the result expected was *draft prototype*  about learning material model of three dimensional shapes of geometry relating to local culture. The instruments needed to support the learning material model to be valid and effective were also realized.

 The next face was validitioan and revision. In this face , the researcher asked a mathematics expert to validate the learning material; and followed by revision. At that time, the process was not long. After giving inputs to the the paper examination, the expert directly gave validation to the learning material. Process of validation about three days, and continued by revision. The reseacher also carried out discussions to many axperts and students to make sure about the learnng material.

 The fase of field testing followed by revision, was learning matefrial test fo many times in the teaching-learning at students of elementary school teacher education. But according to the planning composed, this action would be carried out for the coming year.

 To measure the validity of the learning material, it was used validation sheets of learning material about geometrical shapes of geometry related to local culture. The aspects validated were material construction, the truth and equence of material, and the correctness or in line with language used and local cultrue. The validity used in this early research was *logical and content validity.* Validity learning material of three dimensional shapes in geometry and its teaching-learning in elementary school teacher education was also ditermined by competence experts in teachung- learning of mathematics and the anquete results from students. It was carried for the coming year when the learning materirial was tested in the field.

 **3. RESULTS**

  **a. The result of preliminary research**

 In accordance with the early design, to develop the teaching-learning material of three dimensional shapes of geometry, there should be identification and information analizes of research subject condition. Those anlizes comprised elementary students who were studying geometry especially three dimensional shapes, teachers, and learning material about three dimensional shapes of geometry. The analizes consisted of early  students’ capability about three dimensional concept of geometry, students family economics backgound, condition of the place where students study and the like. Determining mathematics geometrical material, especially three dimensional shapes was also analized. Based on the result of observasion and interview, it was found that the teaching-learning of mathematics especially the material of three dimensional shapes of geometry had not in accordance with the hope; among them were: (1) elementary school teachers’ mastery about interger had not been satisfied; it caused the teaching-learning of three dimensional shapes of geometry was wrong conseptually and the material was not in wright occurence; (2) teaching-learning principles like from concrete to abstract, easy to difficult, simple to complex, enactive to iconic and symbolic did not occur; (3) the running of teaching-learning depended on the teachers’ preference only; (4) methods, aproaches, strategies of teaching-learning were the same as when the teachers studied in elementary schools along time ago; (5) it was clear that teachers had not been ready to carry out the teaching-learning about three dimensioanl shapes of geometry, it was characterized that when students asked her, she could not answered correctly; (6) students faced difficulties when they tried to understand three dimensional shapes of geometry concept, applying the rules in daily problems, and problem solving connected three dimensional shapes; (7) students often complained when the time of learning mathematis arrived. The result of observation and interview with students of elementary school teacher education showed that: (1) not all lectures agreed with three dimensional shapes learning material avalilable; (2) students did not study three dimensional shapes of geometry material comprehensively (3) every mathematics lecturer used their own three dimensional shapes of geometry material reference; (4) they did not get the whole three dimensional shapes of geometry material and how to teach it in elementary schools completey.

 **b. Planning Stage**

 This stage was the time for constructing a solution about problems had been designed from the early investigation. There was the fact that there was no teaching-learning about three dimensional shapes of geometry material agreed by all mathematics education lectures. That was why it was neccesary to make agrement about the three dimensional shapes of geometry material that could be a reference or the source of teaching-learning material in elementary school teacher educations. The construction comprised three dimensional concept, examples of cultural three dimensonal ancient buildings, cube with its width and volume concept, cuboid with its width and volume concept, silinder and its width and volume concept, cone with its width and volume concept, piramide and its width and voloume concept, prism and its width and volume concept. To make sure to students, inductive proves were presented in this case. All concepts were followed by problems exercises in daily life and methods of teaching-learning in the elementary schools.The material and its teaching learning was based on local culture.

 All the material presented, was completed by methods of teaching-lerning of that material in the elementary schools based on local culture and the up to date material sources. By constructing this teaching-learning material, the mathematics lecturers were expected to have the same sources of book; and the material development depended on lecturers’ creativity. By realizing that teaching-learning integer material, the students could be able to master the interger and how to teach it in the elementary schools easily. The construction planning comprised : (a) construction containing reasons of the importance of construction of three dimensional shapes of geometry leaning material for the students, main materials discussed in the teaching-learning material; (b) description of detail material comprising cube and coboid‘ concept follwed by width and volume concept, silider, piramide, cone, prism, and all of those were completed by their volume and width concepts. All the material follwed by methods how to teach it in elementary schools and also exercises in daily life and based on the local culture.

 **c. Validation and Revision**

Expert validation was carried out by mathematics expert from the local department, though she was on task of studying to get her doctor degree, she still had opportunity to vadidate this learning material in the month of July, 2019. It happened when we together tested the student’s last task paper; the reseacher negozited with her, and he agreed to validate the material. The score range that had been constructed in the validated sheet was between 1 – 4. A week later, the validation had already finished, and the validation result was as the following written form. At the beginning of the discussion, that was about the introduction, the validator gave 3 as a score and it was meant to be good, though there were some cases of material that should be repaired. The good category showed that introduction in “teaching-learning of three dimensional shapes material and its teaching-learning in elementary schools”, could be used, though the revision should be continously carried out. In the discussion of early concept; was it in accordance with every day life? In this case, the expert gave 4 as the score. In other words, the early concept presentation was really in accordance with eveyday real life. It showed that the validator agreed with the early concept, with his interpretation was very good. About the material model which was mactched with elementary school teacher students, the expert agreed because he gave 4 as score. It meant that the material had been in accordance with the students’ principles.

 According to the expert, the language used, had been in the good category, though he gave 3 as a score. He stated that in this three dimensional material, there were foreign terms that might make students difficult to understand. In using symbols and other geometricall atributs had allready been good and the expert gave 4 as a score. From the culture point of view, the expert gave 4 as a score, it could be meant that the local culture found in this three dimensional shapes material was good and interisting. In short, this three dimensional shape material had motivated the students and had been interesting for both students and lectures in teaching-learning activites, for the expert gave 4 as a score.

 Based on the validation from the mathematics expert, it could be concluded that the teaching-learning of three dimensional shape material and its teaching-learning in elementary schools could be used by both students and lectures in the elementary school teacher education study program, though to make the the material really complete needs other efforts. Besides, field tests would be carried out in the coming year.

 **4. DISCUSSION**

 Based on the preliminary investigatins, it showed that there were some problems in teaching learning of three dimensional shapes in geometry either in elementary schools or in elementary school teacher education study program. In PGSD study program there had not been three dimensional shapes as the teaching-learning resources for students and lecturers. It was very necessary to establish the three dimensional learning material especially for elementary school teacher education students. It was in accordance with Hagar (2006) had an opinion that “*The success of teaching and learning is also determined by the arranged material compromised among the teachers“.*

The three dimensional learning material consisted of the concept of cube, cuboid, cone, piramide, silinder, and prism. All of those followed by their width and volume concepts, exersises, and ways of teaching-learning in elementary schools. From the validation result it showed that the material was good; it meant that the material could be used in teaching- learning both by the students and mathematics education lectures after the field tests were carried out . It was in accordance with Bray (2007) who said that “ *The teaching-learning material that has been validated by an* expert *validator is worth to be used buy teachers and ready to be admistered to studets“.*

 When expert validation followed by revision had already finished, the reseacher would carried out field testing to elelementary school teacher education students and collected students’ opinios. . But it would be done in the coming year. Learning material about three dimensinal sapes and its teaching-learning in elementary schools based on local culture was considered to be accepted. This teaching-learning material could be used as a reference by both students and mathematics education lecturers in learning the three dimensional shapes of geometry

 **5. CONCLUSION**

 Based on the process and results of this development, it could be concluded that the research result was the teaching-learning three dimensional shapes material in geometry and its width and volume concepts was really valid and effective after completed by field tests. This research was also preseded by early investigation either in elementary schools or a long the process of teaching-learning in elementary school teacher education. That activity was followed by construction planning and at last came to the realization. To make the learning material three dimensional shapes of geometry exelent, the researcher asked the mathematics education experts to validate the learning material of three dimensional shapes.

 The main inputs of the expert validators were as follows ; the expert stated that the the material was good and the language used was also good; with the comment that it was necessary to complete and to change the certain volume formula symbol. Besides, the language used wa also standard language. In short, the teaching-learning material of three dimensional shapes of geometry and its teaching-learning in elementary schools could be used as a reference for both students and mathematics education lecturers after field tests were carried out. Sinse the knowledge is relativey develop from time to time, it will be necessary to complete and might edit this material.

**BIBLIOGRAPHY**

**A**lbert B. Bennet Nelson & Tet Nelson . (2009). *Mathematics for Elementary Teachers. New York: Mc. Graw Hill Company.*

 Armando. (2015). The preparation of teaching-learning model in rural areas.*The International Journal of Eduction.*

 Balmeo. (2009). Extended Analysis: promoting mathematical inquiry with presermathematics teachers. *Journal of Mathematics Education*, 21 (10), 399 – 402.

 Bray, Renold. R. (2007). *Aplied Research and Development in the Field of Education and Psychology.*  Boston : Boston University Press.

Brion Array. (2011) “The Culture Events Effect of The Properties of Local Education.” *Journal of Culture Eduction*, 63(21): 23 -26

 Cafarony Ellaform. (2008). The Effects of Culture on Education. *Journal of Culture Education.* 9 (7), 124 – 132.

Carl Mark (2009) The Importance of Teaching - Learning Geometry**.** *Journal of Mathematics Teacher Education* **,** 27 - 36

Crowley, Marry (2014). The Teaching Learning Material in Education. :  *Journal of Research in Education.* 12 (8), 126 – 135.

Embarskein. (2015). The impact of Culture on Eduction. *Journal of culture education.* 9 (12), 13 -15.

Fuson, K., C., Murray, C. (2001). The development of spacial and geometric concepts . *Journal for Research in mathematics Ecucation, 17, 53-69*.

Hagar Silverstone. (2006). *The teaching and Lerarning of three dimesional shapes in the Eleentary School.* Boston:Gouchi Brothers Publihers.

Joyce & Weil (2016). *Teaching and Learning Models in Mathematics and Science Education*. New York: Mac Graw Hill company.

Plomp. T (2001). *Design methodology and Developmental research on education and*

 *training* . Enchede : Fest.

Rebecca. (2012). The Teaching-Learning Model of the Geometric Development in Elementary School : *Learning and teaching geometry. Journal of Research in Mathematics Education.* 15, 125 – 133.

Rahmi,Aida dan Harmi Hendra. ( 2013). *Pengembangan Bahan Ajar* MI.Curup: Lp2 STAIN Curup.

Rellers . E. (2009). “The Use of Learning Mathematics and Its Implementation”. *Journal of Mathematics Educationan and Research*, 39 (5), 207-208.

### Travers, J. Kenneth. (2008). *Modern geometry*. Belmont: A Division of Double Day &

 Company Inc.

### Van de Vendal, John A. (2009). *Elementary School Mathematics* . New York:

 Longman.