Developing mathematics activity book for kindergarten based on Iceberg theory

A D Handayani*, D Yulianto, D D Yohanie, Samijo and Darsono

Prodi Pendidikan Matematika, Universitas Nusantara PGRI Kediri. Jl. KH. Ahmad Dahlan No 76 Kediri

*apriladiw@unpkediri.ac.id

Abstract. Cognitive development that must be considered in kindergarten is the ability to count which includes the concepts of addition and subtraction. Abstract mathematical concepts are not always well received by kindergarten students. Therefore, to support optimal child development, appropriate stimulants are needed. Some kindergarten students experience still have difficulties in summing numbers abstractly. There are also those who have difficulty in the counting process, both outlining and adding up. In addition, there are also students who are less able to write the large number of objects into numerical symbols. Given the various difficulties that can be experienced by kindergarten students in learning the concepts of addition and subtraction, one way that can be used to introduce the concepts of addition and subtraction in kindergarten students is by using the Iceberg approach. Iceberg is known as an iceberg phenomenon. The process of forming icebergs in the sea always starts from the bottom beneath the surface of the sea and so on finally forms the tip of the iceberg that appears above sea level. The base of the iceberg is wider than its peak, thus the construction of the iceberg becomes sturdy and stable. Introducing a mathematical concept based on the Iceberg approach means that in the iceberg model there are four levels of activity, namely: 1) mathematical orientation of the environment, 2) Model of teaching aids, 3) making of foundations (Building stone), and 4) formal mathematics. With this step it is hoped that kindergarten students who are still in the pre-operational stage can more easily understand abstract mathematical concepts because the concept begins with the introduction of concrete objects around students. The purpose of this study is to developing mathematics activity books based on the Iceberg theory to introduce the concepts of addition and subtraction for kindergarten.

1. Introduction

There are four stages of cognitive maturity in children, which are sequential and interrelated [1]. At kindergarten age, students' cognitive abilities are in the pre-operative stage, children begin to use symbols to show objects and express their thoughts using language. Cognitive development that must be considered in kindergarten age children is the ability to count which includes the concepts of addition and subtraction. Abstract mathematical concepts are not always well received by kindergarten students. Therefore, to support optimal child development, appropriate stimulants are needed. To be able to introduce basic mathematical operations at the level of early childhood is not easy, including by performing addition and subtraction operations using objects that are around, for example by using five balls of the same diameter that can be grasped. For subtraction, the ball is released and for addition, they are asked to take as many balls as specified. This method is an example of an effort to introduce the nature of "increasing" and "decreasing".
In kindergarten, your child will focus primarily on two important areas. The first is learning numbers and what numbers represent. The second is addition and subtraction. Some kindergarten students still have difficulty in adding abstract numbers. This is in line with the results of initial observations and interviews conducted at a Kindergarten School at Kediri. Not all early childhood are good at counting [2]. Some process a long time and it is difficult to calculate the number of objects. Another difficulty is connecting the number of objects with the number symbol. At the advanced level, students have difficulty in simple arithmetic which is addition and subtraction. During the early childhood years, children develop several mathematical skills such as subitizing (i.e., instantly seeing how many with small quantities), verbal and object counting, and early addition and subtraction that form the foundation for later mathematics learning at school [3].

Given the various difficulties that can be experienced by kindergarten students in learning the concepts of addition and subtraction, one way that can be used to introduce the concepts of addition and subtraction in kindergarten students is by using the Iceberg approach. Iceberg is known as an iceberg phenomenon. The process of forming icebergs in the sea always starts from the bottom beneath the surface of the sea and so on finally forms the tip of the iceberg that appears above sea level. The base of the iceberg is wider than its peak, thus the construction of the iceberg becomes sturdy and stable. Introducing a mathematical concept based on the Iceberg approach means that in the iceberg model there are four levels of activity, namely: 1) mathematical orientation of the environment, 2) Model of teaching aids, 3) making of foundations (Building stone), and 4) formal mathematics.

Iceberg’s approach taken to introduce the concept of addition and subtraction in kindergarten students is realized in the form of teaching materials in the form of teacher books and student activity books. In Iceberg’s first stage, the introduction of the concepts of addition and subtraction to students begins with presenting concrete objects to students and stories about addition. Second, students are asked to draw objects that have been mentioned in the previous stages. Third, students are introduced to the concepts of addition and subtraction in mathematics. At the peak stage of Iceberg, students are introduced to the formal concepts of speaking and subtraction, including recognizing the "plus" and "minus" signs.

A related research show that students can understand the concept of multiplication well through Palembang’s special food as a starting point for learning Iceberg [4]. Therefore, in this study teaching materials will be developed with the Iceberg approach to introduce the concepts of addition and subtraction in kindergarten students with a starting point in the form of concrete objects around the learning environment. Mathematical competence as “a well-informed readiness to act appropriately situations involving a certain type of mathematical challenge”.

2. Methods
2.1 Development Model
This study uses the 4D development model which includes 4 stages: define, design, develop and disseminate [5]. This model was chosen because the steps of the activities in this model are arranged systematically so that it can be used for textbook development.

2.2 Development Procedure
The define stage starts with defining and defining learning needs. This defining phase includes four main steps, namely the initial-end analysis, student analysis, task analysis and concepts and goal analysis.

At the design stage (design) aims to design learning tools. The steps at this stage include; (1) selection of media (media selection) in accordance with the characteristics of the material and learning objectives, (2) selection of format (format selection), namely reviewing the complementary textbook formats that exist and determine the format of complementary textbooks to be developed, (3) make an initial design (initial design) according to the chosen format.

The develop phase is marked by revising and modifying the prototype through testing activities. The development phase is the stage to produce development products which are carried out through two steps, namely (1) expert appraisal followed by revision, (2) developmental testing. The purpose of this
development stage is to produce the final form of learning tools after going through revisions based on expert or practitioner input and trial data. The eligibility criteria for validation of the enrichment book components developed include: a. Feasibility of content, consisting of: (1) compatibility of contents with competencies and objectives of lectures; (2) conformity with the development of students; (3) compatibility with learning needs; (4) the truth of the material substance; (5) expediency in adding educational insights to the remaining mathematical concepts of kindergarten; (6) conformity with values (moral values and social values). b. Linguistics, including components: (1) legibility; (2) clarity of information; (3) conformity with good and correct Indonesian language rules; (4) effective and efficient use of language. c. Presentation, including components: (1) clarity (indicators) to be achieved in the use of teaching materials; (2) the order of presentation; (3) completeness of information. d. Graphic, including components: (1) use of fonts (type and size); layout (layout); (3) illustrations, drawings, photos and display designs. In the Development stage, teacher books and student activity books will be produced according to Iceberg's approach to the addition and subtraction material.

Disseminate stage (deployment) is a final stage of development. Dissemination phase is carried out to promote development products to be accepted by users, both individuals, a group, or the system. In this study, the dissemination stage was carried out in a limited level, that is only within the scope of the kindergarten used as a research.

3. Result and Discussion
3.1. Iceberg Approach
Initially students develop a model or method that suits their understanding [2]. This model is still contextual and specific to the given problem model. This model is the basis for developing formal mathematical knowledge. After the process of generalization and formalization the model is gradually directed towards the model for mathematical thinking at a formal level as shown in Figure 1 below.

Figure 1. Model development in PMR

Figure.1 shows that students do not realize that the activities they often play have to do with what they will learn. Therefore, it requires an activity where the teacher connects students' mathematical experiences in class which calls the mathematical stage of environmental orientation. The type of realistic approach in the idea of the iceberg floating in the middle of the sea [6]. The process of forming icebergs in the sea always starts from the bottom of the sea surface and so on finally the tip of the iceberg.

The base of the iceberg is wider than its peak, thus the construction of the iceberg becomes sturdy and stable. In relation to the formation of mathematical concepts, formal mathematics is only the ultimate goal. To achieve this goal, a series of efforts are needed that are the foundation for the mathematical concepts learned to be truly understood and meaningful to students. In the Moerlands iceberg model, there are four levels of activity, namely: (1) mathematical orientation of the environment, (2) a model of teaching aids, (3) building a foundation (building stone), and (4) formal mathematics. To link play activities with concepts to be learned, mathematical orientation of mathematical activities is
very important. At this stage children will be accustomed to solving everyday problems without having to hastily associate with formal mathematics. Children will model the situation of mathematical problems related to the given context. Mathematical activities that come in contact with a variety of real contexts leading to a mathematical concept will be the foundation for students at the next level.

3.2. Mathematical Concepts for Kindergarten Students

Early childhood is often referred to as “golden age” or golden period. At this time almost all the potential of children have a sensitive period to grow and develop rapidly and greatly. Early childhood is often referred to as “golden age” or golden period. At this time almost all the potential of children have a sensitive period to grow and develop rapidly and greatly [7]. Especially for early childhood or preschool, mathematics is very useful for them to develop thinking processes. Mathematics learning that is given at the level of early childhood is still non-formal in nature, where the child has not been fully given the actual mathematical material but is only an introduction. In mathematics education can be given for example in the introduction of numbers, numbers are played first by mentioning the numbers one, two, three and so on. And showing objects numbering one, two, three and so on, does not mean the material immediately introduces the symbol “two” because the child will be confused. With increasing intelligence and age are introduced to numbers. Mathematics learning is a branch of subjects whose scope is very broad and not only can count but also includes competencies that make the child understand and understand about mathematical concepts. Mathematics education can be given to children at an early age with the method of learning by playing or learning while playing, because when playing time children will get the opportunity to explore, experiment and freely express themselves. By playing, children will unintentionally understand certain mathematical concepts and see the relationship between one object and another. Besides that we must remember that playing is important in a learning process of kindergarten. So by play and do the activity, student will learn mathematics with fun.

One of the focal points when teaching mathematics in the early years is to help the children understand quantity [8] and to encourage the development of a strong sense for numbers [9]. Mathematics is an exact science that is the basis of other sciences, so that Mathematics is interrelated with other sciences. Mathematics is a language, because mathematics is a symbolic language that applies universally and is very dense of meaning and understanding. As an art, in mathematics there is order and consistency, while as the queen of knowledge, mathematics is language, deductive science, the science of order, the science of structure that is well organized 3 and is a steward of other sciences [10].

Mathematical Standard Content for Early Childhood

Mathematical standard content for early childhood are [11]: 1. Numbers and operation Is one of the mathematical abilities used by children in the concept of numbers or understanding numbers, which makes the relationship between the operation and the number is marked by addition and subtraction. 2. Algebra Is one of the mathematical abilities used by children in the systematic number that has a pattern naturally and structured. 3. Geometry Children recognize geometric shapes 4. Measurement Is one of the mathematical abilities used by children, which involves numbers to determine the size of an object so the numbers that are the results of that measurement, can be compared to similar objects.

Stages of Introducing Mathematics in Early Childhood.

Three stages of mastery of numeracy skills:

1. Mastery of Concepts. Concept mastery is a stage that begins by forming an understanding or understanding of something using concrete objects and events, such as the introduction of colors, shapes, and counting objects / numbers. 2. Transition Period The process of thinking which is a transition from a concrete understanding to the introduction of an abstract symbol, where the concrete objects still exist and begin to be introduced to the symbol. 3. Symbols Is a visualization of various concepts. For example lambing 7 to illustrate the concept of number 7, red to symbolize the concept of red [12].

The purpose of learning mathematics from an early age is divided into two, namely general goals and special goals. The general objective is for children to know the basics of learning to count / mathematics, so that in time the child will be better prepared to follow mathematics learning at the next level of education which is more complex. Whereas the specific goal is to be able to think logically and systematically from an early age through observation of concrete objects, pictures or figures contained.
around children, to be able to adjust and involve themselves in community life which requires calculating skills, accuracy, concentration, abstraction and high appreciation power. Having creativity and imagination in creating something spontaneously.

Characteristics of Kindergarten Children Learning Methods are: 1. Children learn through play. 2. Children learn by building knowledge. 3. Children learn naturally. Characteristics of children begin to like counting games include: Children begin to mention the sequence of numbers without understanding, Children begin to count objects that are around him spontaneously, Children begin to compare comparing objects and events that are around him, Children begin to add up add up or subtract accidental figures and objects.

3.3 The Process to Develop Mathematics Activity Books for Kindergarten.

The activity books that develop to teach addition and subtraction in kindergarten is also a picture books. Picture books are one of the most frequent media used in kindergarten education. Through children's picture books facilitated in concentrating understanding through the presentation of attractive images. Picture books as a graphic medium that communicate facts and ideas clearly and powerfully through a combination of words and pictures. There are lots of picture book developments in introducing a certain material, like addition and subtraction.

Figure 2 is an example of the activity books that are develop in this research.

From the figure 2, student can start the process to learn about addition by using an activity to hear the story that can be read by the teacher. After that, student get the ilustration of the object on the story. Then, student must count how many in each box. The student coloring the circle below the object by same color and as many as the object above. So, at the end of activity, student try to write the number of object at each box and write the symbol plus (+) and equal (=).

At the figure 3, it shows the result of the book activity draft that was do by the student. For noted, on this pandemic era, the student do it at home by herself.

From Figure 3, we get the student can do addition by doing the activity coloring and count the circle as a representation of candy and study about the number symbol and the symbol of addition.
That activity books is also train student to learn about problem solving. Today, critical thinking, problem solving, reasoning ability and the ability to communicate mathematically are essential skills [13]. We can see the result of the activity that do by kindergarten student on Figure 3.

Children’s early experiences of mathematics form the foundation for their future mathematics learning and success. Mathematics enables children to think logically, strategically, creatively and critically. Mathematical knowledge and skills provide building blocks for success in many areas of life and work.

4. Conclusion
The conclusion of this article obtained an interesting mathematics activity book for kindergarten based on the iceberg theory. By using the mathematics activity book, it is hoped that students will more easily understand the concepts of vocabulary and subtraction because in the book, students are first introduced to mathematical concepts that are close to their daily lives. So that in the next stage students will be able to understand both abstract symbols and mathematical concepts.

5. References
[1] Septiana R Putri R I I and Hartono Y, 2017 Mengenal Ukuran dengan Pendekatan PMRI pada Aspek Kognitif Pendidikan Anak Usia Dini Jurnal Pendidikan Anak 6,2 p. 137-148
[2] Novitasari W, 2016 Analisis Kesulitan Belajar Anak Usia 5-6 Tahun Jurnal Eksakta 1, p 19-25
[3] Mononen R, 2014 Investigating RightStart Mathematics Kindergarten Instruction in Finland. Journal of Early Childhood Education Research 3,1 p 02-26
[4] Retta A M, 2016 Penggunaan Iceberg dalam Pendekatan Pendidikan Matematika Realistik Indonesia (PMRI). Prosiding Seminar Nasional Pendidikan FKIP Universitas Muhammadiyah Palembang 1, 1
[5] Niss M Hoojgaard T, 2011 Competencies and Mathematical Learning: Ideas and Inspiration for the Development of Mathematics Teaching and Learning in Denmark
[6] Ambarini R Setyaji A Suneki S, 2018 Teaching Mathematics Bilingually for Kindergarten Students with Teaching Aids Based on Local Wisdom English Language Teaching 11, 3
[7] Nonesuch K, 2008 Family Math Fun Manual for The Project Parents Teach Math: A Family Literacy Approach Office of Literacy and Essential Skills, Human Resources and Skills Development Canada
[8] Rasmusson M, 2008 Teaching Number Sense to Kindergarteners. Malmö högskola Lärarutbildningen Natur, miljö, samhälle
[9] Sugiman, 2011 Peningkatan pembelajaran Matematika dengan Menggunakan Pembelajaran Matematika Realistik
[10] Haji S, 2013 Pendekatan Iceberg dalam Pembelajaran Pembagian Pecahan di Sekolah Dasar. Infinity Jurnal Ilmiah Program Studi Pendidikan Matematika STKIP Siliwangi Bandung 2.1
[11] Juita R, 2003 Peningkatan Kemampuan Berhitung Anak Melalui Permainan Menakai Air di TK Aisyiyah Koto Kaciak Maninjau Jurnal Pesona PAUD 1, 1 p 20
[12] Mapp K and Herderson A, 2002 Doing Mathematics with Your Child, Kindergarten to Grade 6: A Parent Guide. Ontario
[13] Ministry of Education, 2015 Spotlight on Mathematics/Pangarau.