Students' ability to simplify the concept of function through realistic mathematics learning with the ethnomathematics approach

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Abstract. The concept of function was a basic concept that students must understand in mathematics learning. This concept needs to be implicated through realistic mathematical learning with the ethnomathematics approach. The purpose of this study was to describe students' ability to simplify the concept of function through realistic mathematical learning with the ethnomathematics approach. This was part of the research development. This stage was the prototype phase. We apply realistic mathematics learning with the ethnomathematics approach. The instrument of this research was the assignment sheet and the in-depth interview sheet by the researcher. Data was collected through task-based interviews. It was analyzed qualitatively. The results of this study were that students were able to simplify the concept of function through realistic problems based on "andun dance" culture. He simplifies the concept of mapping. For example, f was a function from set A to B, students were able to simplify the concept of function f with Df = A (domain function f was A). Also, being able to explain with various real examples and being able to show the position of the concept of function in a deductive structure of mathematics. The conclusion of this study was that realistic mathematics learning with ethnomathematics approach can be a vehicle for students to simplify the concept of function to be more meaningful.

1. Introduction
Mathematics was an important subject for middle school students. It was one vehicle to develop the ability to think logically. However, we found many middle school students who had difficulty understanding mathematics [1]-[2]. This was natural, because mathematical objects were abstract, as were mathematical objects taught in schools [3]. Therefore, it was necessary to simplify these objects. Students were psychological beings, who develop according to the stages of cognition. When sitting in junior high school, according to Piaget students were in the concrete operational stage [3]. It was the stage that requires concrete objects. To achieve a mathematical concept, it takes action and interaction with friends, with the teacher and with learning resources [4]. It was done through an abstraction process. This process can be done, because students were active information processors. They were able to represent each information according to the level of knowledge they have. It was used as a representation structure of knowledge stored in its memory [5].

To carry out actions and abstraction processes as a fellowship extraction from a set of examples, and categorization that corresponds to each other [6]. The process of abstraction of mathematical objects was to focus on the similarity of properties and relationships between objects, more than just
the object itself. Abstraction results were a class of all objects that can distinguish characteristics and pay attention to differences in relationships [7]. This was what makes students difficult to learn mathematics. Therefore, the simplification of abstract objects in mathematics was needed, becoming more concrete. Mathematics was a human activity [8]. It gives the view that the mathematical process can be done horizontally [9]. It was oriented towards the minds of students and the surrounding culture. Local culture and wisdom produce meaningful learning. That was often called the ethnomathematics approach [10].

We find students have difficulty understanding the concept of function. Though the concept of function was very important in mathematics, and in everyday life. It was often not explicitly called a function [11]. The idea of the concept of function can be considered as a result of human efforts to make peace with the changes observed and experienced in the world around them [12]. Therefore, the difference in intention and extension of a definition turns out to provide a clue to the existence of simplification. The simplification of the function definition was the narrowing of the loading set of the initial elements of the sequential set of pairs [11]. The general aspects of the concept image of student functions were identified. These images include: (a) functions must be given by a single rule, (b) graphs of functions must be continuous, (c) functions must be one-to-one, (d) functions must include some algebraic formulas, (e) graphs the function must pass the vertical-line test, and (f) a function must be systematic - arbitrary correspondence was not considered a function [12]. Most students have difficulty understanding the formal definition of a function. This has a negative impact on their learning formal definition of a function [13]. Learning about the concept of function was a prerequisite for understanding many concepts. Without understanding it, learning other concepts in mathematics will experience many obstacles [14]. Therefore, in the simplification of the concept of function, a contextual problem was needed. This problem makes it easier for students to do horizontal mathematical. It was mathematics learning that was close to the minds of students and local culture. Thus, ethnomathematics was the right approach for learning function concepts.

The ethnomathematics approach can and does integrate mathematics into the curriculum. It seeks to recognize the contributions, values, rights and equality of opportunity of all cultural groups that make up a particular society [15]. Mathematics teachers were challenged to handle the cultural diversity of people that occur in each classroom. Ethnomathematics clearly have gained an important role, in the curriculum, being meaningful in exploring various aspects of mathematical literacy [16]. Ethnomathematics learning can improve students' metacognitive abilities [1]. This approach can improve mathematical communication skills [17], improve problem solving skills [2], improve mathematical understanding skills [18]. The average ability of students' mathematical communication learned using material oriented to ethnomathematics was higher than that given by non-ethnomathematics [17].

Ethnomathematics has become a common practice throughout the world. It has been extended from exotic interpretations to intercultural learning methods that apply in any learning context. Dealing with cultural diversity in class was a universal context in which each specific context has its place [16]. The scope of ethnomathematics ranges from field reports about the use of mathematics by various cultural groups, to applications in classrooms, cross-cultural projects, and theoretical discussions about the basis and direction of ethnomathematics [19]. There was a significant difference between the average scores of students taught with ethnomathematics teaching approach and those taught by conventional approaches. It should be the implementation of the ethnomathematics approach in their daily lessons especially for the purpose that learning becomes meaningful, relevant and interesting [20]. Thus, the ethnomathematics approach was expected to be a means to simplify the concept of functions for middle school students. That was a very appropriate approach. Through learning mathematics with the ethnomathematics approach, students can easily carry out mathematicization processes. It starts from objects that were close to the daily lives of students.
2. Methods

The study was part of developmental research. It was part of these study. The subject of this study was Middle School students in Bengkulu. Subjects were selected through the intact group of 36 students. We apply realistic math learning with the ethnomathematics approach. The research instruments were observation sheets, assignment sheets and in-depth interview sheets by researchers. Data were collected through observation and task-based interviews. Data were analyzed descriptively qualitatively.

3. Results and Discussion

During the implementation of the research, we implemented the ethnomathematics approach in realistic mathematics learning. It was an approach that aims to simplify the concept of function. We apply in a regular class of junior high school students in Bengkulu. Before and during the implementation of learning we collaborated with teachers at the school. Our collaboration was to do an initial reflection, through needs assessment. It was continued with the preparation of learning planning with the ethnomathematics approach. During the learning process, we observe the teacher in the class. After the learning process we conducted in-depth interviews, about simplification of the concept of functions that we compiled.

Based on interview data based on assignments, and observations during mathematics learning were realistic with ethnomathematics approach, we analyze and the results were as follows: “Andun dance” was our choice to arrange assignment sheets for students in carrying out the process of horizontal mathematization.

Andun dance was one of the traditional dances originating from the Bengkulu region, Indonesia. This dance was a type of social dance that was usually performed by male dancers and female dancers. Andun dance was a fairly well-known traditional dance in Bengkulu, especially in the South Bengkulu [21]. It was a traditional dance ceremony called Nundang Padi as a series of traditional ceremonies. Andun dance was displayed on the first day and the third day, the first day functions as entertainment taken by the community, then the third day was danced by teenagers and functions as fertility [22]. There were two groups of dancers, the first group was female peneri (see Figure 1).

![Figure 1. Andun dance, women's group](https://blogkulo.com/tari-Andun-bengkulu/)

In the implementation of danun dance, besides the girl group, dancers were also danced by young men in pairs. The composition of the dancers was very much associated with danun dance history. It was a dance that was originally used as a means of finding a mate during the rice harvest season. Andun dance was held at night accompanied by traditional musical instruments called Kolintang [23]. The following was the second group of male dancers (see Figure 2).
The female group members were chosen by the group dancer to be their partner [22]. Usually a woman pairs exactly one man. Suppose that a group of women consists of: a1, a2, a3, a4, a5, a6, a7, a8. Also, B was a group of men consisting of: b1, b2, b3, b4, b5, b6, b7, b8, b9. Accompanied by Kolintang, the dancers rejoiced and found their respective partners. Suppose pairs occur (a1, b3), (a2, b6), (a3, b7), (a4, b5), (a5, b8), (a6, b1), (a7, b4), (a7, b4), (a8, b2). It was a sequential pair of girls and boys, with terms (ai, bk) and (ai, bj) were pairs that occur then bk must be the same as bj. This can be seen by one partner, which can be seen in Figure 3.

The simplification process from Figure 1 to Figure 3 was one part of the student worksheet. It was a mathematical process that was close to the thoughts and culture of students. During the learning
process we make observations. The observations show the activities of students who support their cognitive processes (see Figure 4).

![Figure 4. Observations in the learning process](image)

Based on Figure 4, from 100% of learning time was used by students to carry out active learning. That was done during the realistic mathematics learning process with the ethnomathematics approach. Note that, 10% of students give ideas, 8% respond, 9% help friends, 12% make hypotheses, 27% collect data, 20% make solutions and 15% conclude. That was to show that students were really actively involved in the learning process. Even students were in control of the learning process. It was very good, students dominate learning. Therefore, it was natural that students can improve their mathematical abilities. The mean of comprehension ability of concept for students taught by Contextual Learning Model better than Conventional Learning Model; and the mean of Problem-Solving Ability for students taught by Contextual Learning Model was better than Conventional Learning Model [24]. Students' mathematical communication skills learned using material oriented to ethnomathematics were higher than those given by non-ethnomathematics. Also, students' mathematical communication skills taught with realistic mathematics learning approaches were higher than those taught by traditional learning approaches [17].

Learning outcomes show that students can simplify abstract concepts through contextual problems, namely danun dance culture. Based on this, students make mathematical as follows. For example A = \{a1, a2, a3, a4, a5, a6, a7, a8\}, B = \{b1, b2, b3, b4, b5, b6, b7, b8, b9\}. \(A \times B = \{(ai, bj) | ai \in A, bj \in B; i = 1, ..., 8; j = 1, ..., 9\}\). The set of sequential pairs that occur was \(f = \{(a1, b3), (a2, b6), (a3, b7), (a4, b5), (a5, b8), (a6, b1), (a7, b4), (a7, b4), (a8, b2)\}\). That was to show that for each \((ai, bk)\) and \((ai, bj)\)\(\Rightarrow bk = bj\). This was building a function \(f\). In accordance with the function definition. Let \(A\) and \(B\) be a set. Then a function from \(A\) \(B\) was a set of ordered pairs in \(A \times B\) such that if \((a, b)\) and \((a, b')\) \(\Rightarrow cf\), then \(b = b'\) [25].

In learning, students were able to simplify the concept of function based on danun dance pairs. The simplicity was obtained like Figure 5.
Figure 5 shows that students have the ability to simplify concept definitions through concept images [25]. Students state that Domain of \( f \) (\( Df \)) was set A. The code was B, and the range was \( Rf = \{b1, b2, b3, b4, b5, b6, b7, b8\} \). Students were able to simplify the concept of function through realistic problems based on "adun dance" culture. He simplifies the concept of mapping. For example, \( f \) was a function from set \( A \) to \( B \), students were able to simplify the concept of function \( f \) with \( Df = A \) (domain function \( f \) was \( A \)). Also, being able to explain with various real examples and being able to show the position of the concept of function in a deductive structure of mathematics. The conclusion of this study was that realistic mathematics learning with ethnomathematics approach can be a vehicle for students to simplify the concept of function to be more meaningful.

4. Conclusion
Students were able to simplify the concept of functions from very general definitions to definitions that were simpler and easier to understand. They take advantage of contextual problems with ethnomathetics approach, namely danun dance. The simplification of the formal definition by using sequential pairs was a concept figure. During ethnomathematics learning, students were very active, and greatly dominate learning.

References
[1] Herawaty D, Widada W, Novita T, Waroka L and Lubis A N M T 2018 Students’ metacognition on mathematical problem solving through ethnomathematics in Rejang Lebong, Indonesia J. Phys. Conf. Ser. 1088 012089
[2] Widada W, Herawaty D, Falaq A, Anggoro D, Yudha A and Hayati M K Ethnomathematics and Outdoor Learning to Improve Problem Solving Ability Advances in Social Science, Education and Humanities Researchvol 295 (Paris: Atlantis Press) pp 13–6.
[3] Widada W 2004 Pendekatan Pembelajaran Matematika Berbasis Masalah( Surabaya: Unipa Press)
[4] Widada W 2016 Sintaks model pembelajaran matematika berdasarkan perkembangan kognitif peserta didik J. Pendidik. Mat. Raflesia 1 163–72
[5] Widada W 2016 Profile of cognitive structure of students in understanding the concept of real
analysis. *J. Math. Educ.* 5 83–98

[6] Widada W and Herawaty D 2009 Development of student schemes (level triad ++) about real analysis FKIP Universitas Bengkulu pp. 1–20

[7] Widada W, Sunardi H, Herawaty D, Pd B E and Syefriani D 2018 Abstract level characteristics in solo taxonomy during ethnomathematics learning *Int. J. Sci. Res.* 7 352–5

[8] Hans F 1991 *Revisiting Mathematics Educational* (Dordrecht: Reidel Publishing)

[9] Gravemeijer K 1994 *Developing Realistic Mathematics Education* (Utrecht: Freudenthal Institute)

[10] D'Ambrosio U 2001 What is ethnomathematics, and how can it help children in schools? *Teaching Children Mathematics* 7 308

[11] Soedjadi 1993 *Simplify Some Concept In Mathematics For School Mathematics And Its Impact.* (Surabaya: IKIP Surabaya)

[12] Viirman O 2014 *The function concept and university mathematics teaching dissertation* (Karlstad: Karlstads Universitet)

[13] Jannah U R, Nusantara T, Sudirman and Sisworo 2019 Students’ characteristics of students’ obstacles in understanding the definition of a function *IOP Conf. Ser. Earth Environ. Sci.* 243 012134

[14] Kashefi H, Ismail Z and Yusof Y M 2010 Obstacles in the learning of two-variable functions through mathematical thinking approach *Procedia - Soc. Behav. Sci.* 8 173-80

[15] Orey D C and Rosa M 2004 Ethnomathematics: Teaching and learning mathematics from a multicultural perspective *J. Math. Cult.* 1 139-48

[16] François K 2010 The role of ethnomathematics within mathematics education *Cent. Log. Philos. Sci. Free Univ. Brussels* 1517–26

[17] Widada W, Herawaty D, Yanti D and Izzawati D 2018 The student mathematical communication ability in learning ethnomathematics oriented realistic mathematics *Int. J. Sci. Res.* 7 881–4

[18] Herawaty D, Widada W, Umam K, Nugroho Z, Falaq A and Anggoro D 2019 The improvement of the understanding of mathematical concepts through the implementation of realistic mathematics learning and ethnomathematics *Adv. Soc. Sci. Educ. Humanit. Res.* 295 21–25

[19] Shirley L and Palhares P 2013 The role of ethnomathematics in mathematics education *Rev. Latinoam. Etnomatemática* 6 4–6

[20] Achor E E, Imoko B I and Ulok O E S 2009 Effect of ethnomathematics teaching approach on senior secondary students’ achievement and retention in locus *Educ. Res.* 4 385-90

[21] A 2015 *Tari Andun Tarian Tradisional Dari Bengkulu Negeriku Indonesia*

[22] Mizliati S, Ediwar and Surherni 2014 Ekstensensi tari andun dalam upacara adat nundang padi masyarakat pino raya J. *Pengkaj. dan Pencipta. Seni* 2 173–8

[23] A Tari Andun

[24] Herawaty D and Widada W 2018 The influence of contextual learning models and the cognitive conflict to understand mathematical concepts and problems solving abilities *Adv. Soc. Sci. Educ. Humanit. Res.* 218 96–102

[25] Bartle R G and Donald R S 1982 *Introduction to Real Analysis* (New York: John Wiley & Sons)