Increasing students’ mathematical communication skills by applying probing-prompting learning model based on Belu culture artefact

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Abstract. This research is a Classroom Action Research that aims to improve students' mathematical communication skills through a probing-prompting learning model based on Belu culture artefact. The research subjects were all students of class VIII-A at Atambua State Junior High School 2 with totaling 39 students. The research was conducted in two cycles, that each cycle consists of two lessons in topic cube and cuboid. Data were collected using observation, test, and documentation techniques. The data were analyzed descriptively. The results show that the students’ mathematical communication skills increase from the first cycle to the second cycle after applying a probing-prompting learning model based on Belu culture artefacts. It is indicated by as much as 72.22% of students experiencing an increase in the total score of aspects of mathematical communication skills. Also, the implementation of learning reached 83.33% in the excellent category. Based on the observation results, students’ mathematical communication skills increase from 74.13% (good category) on the first cycle to 85.68% (good category) on the second cycle. It can be concluded that the application of probing-prompting based on Belu culture artefacts can improve students’ mathematical communication skills.

1. Introduction
Education is an important process in human life to prepare and improve the quality of human resources. The educational process in a very broad sense can be defined as a change in understanding the outside world and its relationship with others and objects in the environment. Mathematics has an important role in efforts to increase the quality of human resources. Mathematics is the basis of the development of science and technology whose influence is very important in everyday life. Therefore, mathematics becomes a compulsory subject in all education levels. It is expected that studying mathematics enables us to think logically, analytically, systematically, critically, and creatively and be able to work together in a community.

One goal of learning mathematics is communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problem. To show the learning objectives can be used several related things for example through presenting mathematical statements orally, in writing, pictures, and diagrams. Therefore by submits allegations and manipulates mathematics, students can draw conclusions, compile evidence, give reasons for freedom of solutions, and finally can also check the validity of an argument.

Based on the results of interviews with mathematics teachers in grade VIII students of SMP Negeri 2 Atambua, it was obtained that students had difficulty mastering mathematics, students were not accustomed to solving problems step by step and rarely included pictures to make it easier to solve given
questions. This can also be seen from the lack of understanding of students when faced with a non-routine problem. Students are not accustomed to writing down what is known and what is asked of the problem before finding a solution. It makes some mistakes to interpret the purpose of the problem. Most students get difficulty to change a contextual problem into a mathematical model. It shows that students’ mathematical communication skills are still relatively low.

Mathematical communication is one that is expected to be well developed so that students can convey mathematical ideas both in writing and orally [1–3]. Related to the low mathematical communication skills of students, it needs to improve mathematics learning. The learning model is a pattern used by teachers in developing curriculum, organizing teaching materials, and giving instructions in learning settings [4–6]. The probing-prompting learning model is one of the many cooperative learning models that are considered able to improve students' mathematical understanding and conceptual communication abilities [7–9]. In the probing-prompting learning model, the teacher presenting a series of questions that are guiding students in learning and linking students' knowledge and experiences with the new one to be learned, then new knowledge is constructed by students rather than informed by the teacher directly [10,11].

Artefacts, in archaeology, mean objects (natural materials) that are made by (human) hands or observable the presence of man-made traces on them (not merely natural objects) through reduction technology or additional technology [12,13]. An important characteristic in the concept of artefacts is movable. The objects can move or can be moved easily (relatively) without destroying their shape. One of the famous artefacts often used by the Belu community is betel nut known as Koba. It is the original form of Belu culture. When associated with cultural elements, Koba is included in the system of equipment and technology in the form of a container or a place to hoard, load, and store goods [14–16].

Integrating culture in mathematics learning makes students interested in learning mathematics [16–18]. Thus can improve mathematical knowledge and skills. This is because mathematics is shaped by culture, influenced by culture, and influences culture [19–22]. Besides that, mathematics is a cultural phenomenon as a pan-human activity [23–25].

The implementation of probing-prompting learning model based on Belu Culture artefact in this research is as follow: (1) Teacher informs Belu culture by displaying Koba and images related to Belu culture to increase student knowledge about cultures that develop in students' real environments (2) Teacher provides opportunities for students to ask questions related to the culture presented. (3) Teacher gives examples of problems in daily life regarding the material of cubes and cuboid and is related to Belu cultural artefacts (4) Teacher provides opportunities for students to observe or make examples of problems regarding cubes and cuboid and related to Belu cultural artefacts by conducting small discussions group (5) Teacher appoints one student to answer if there is difficulty in solving of given problems. (6) The teacher asks responses from other students about the answers to ensure that all students are involved in the ongoing activity. However, if the given answer is incorrect, then the teacher asks other questions whose answers are a guide to the completion of the answer. Then, the teacher gives questions that require students to think at a higher level, so students can answer questions according to basic competencies and indicators. The questions asked in step six should be given to several different students so that all students are involved in all activities. (7) The teacher gives mathematical communication test questions about the material of the cube and cuboid related to Belu cultural artefacts. However, Indicators of communication skills used in this study are grammatical competence, discourse competence, sociolinguistic competence, and strategic competence [26].

2. Method
This research is a classroom action research. The research design consists of 4 stages, namely the stages of planning, action, observation, and reflection [27,28]. The study was conducted in two cycles. Each cycle consists of two lessons with learning topics about cube and cuboid especially surface area and volume of cube and cuboid. The learning process employed a probing-prompting learning model and based on Belu culture artefact known as Koba (betel nut). The subjects of this study were students of class VIII-A at SMP Negeri 2 Atambua in the academic year 2017/2018 with totaling 39 people. The instruments used in this study were observation sheets, field notes, and mathematical communication skills test questions. Mathematical communication skills consist of grammatical competence, discourse
3. Result and Discussion

The learning process begins with introduce Koba or commonly called betel nut which is a typical artefact of the Belu community. Koba is used to presenting betel and areca nuts to guests or used in traditional ceremonies. The learning together with Koba bringing up some obstacles, especially the activeness of students because for students it is a new thing in learning mathematics. This only happened at the first lesson of cycle I. However, at the second lesson in cycle I and cycle II the students began to get accustomed to the probing-prompting learning model based on Belu cultural artefacts called Koba (betel nut).

At the beginning of learning, the teacher informs learning objectives and motivates students by setting an example in everyday life. It is intended that students are motivated in learning because they already have an overview of the material to be studied. According to the Ministry of National Education, motivating an effort made by teachers to motivate students to play a full role during the learning activities process and to arouse students' attention to the material being studied [29].

After providing motivation and learning objectives, the teacher displays Koba which is a betel nut to be introduced to students in achieving learning objectives. The teacher asks questions with students regarding the objects displayed. This is intended so that students can communicate comfortably in expressing opinions or ask questions to exchange understanding so that it supports the construction process of student knowledge [30,31].

In the work phase of the student worksheet in group discussions, students are trained to be able to clarify or students are trained to make guesses or make predictions about the relationships between concepts contained in the worksheet. In predicting the relationship between these concepts, students' ability to express ideas or ideas from a problem is also honed because the questions given in the worksheet are questions that are both guiding and probing.

After students carry out discussions, students have the opportunity to present or present the results of group discussions in front of all their classmates. Presentations provide opportunities for students to express their opinions so that students feel valued and finally feel happy following the learning [32].

At the group presentation stage, students dare to present the results of their discussion in front of the class. So the teacher does not need to appoint one of the group's representatives to present the class. They have chosen their group representatives who are well-considered able to present the results of their discussions.

In the implementation of group discussions, there are several obstacles faced such as lack of understanding of students in completing worksheets and lack of active students in discussions especially if students face difficulties. Some students who tend to be passive in cycle I, gradually become active in discussions in cycle II. Based on observations, it can be seen that the difficulty of students in understanding a material causes students to be passive in group discussions. However, the difficulties faced by students in understanding the material can be minimized by the explanation made by the teacher.

Based on the observation results, students' mathematical communication skills increase from 74.13% (good category) on the first cycle to 85.68% (good category) on the second cycle. Indeed grammar competence increases from 72.61% in the first cycle to 87.64% in the second cycle, discourse competence increases from 75.73% in the first cycle to 86.38% in the second cycle, sociolinguistic competence increases from 74.54% in the first cycle to 84.25% in the second cycle, and strategic competence also increases from 73.64% in the first cycle to 84.25% in the second cycle. The increase is the impact of the application of the probing-prompting learning model based on Belu cultural artefacts. Besides, the carry-out learning process using probing-prompting increases from 76.82% (good category) to 83.33% (very good category)

The test results also show that the average score of each aspect of students' mathematical communication from cycle I to cycle II increases. Grammar competence increases from 6.28% to 7.21%; discourse competence increases from 6.67% to 6.72%, sociolinguistic competence increases from 11% to 11.6%, and strategic competence increases from 12.5% to 13.8%. Mathematical communication is
not just the students’ ability to express ideas through writing but also the ability in terms of speaking, explaining, describing, listening, asking, clarifying, cooperating (sharing), writing, and finally report on what was learned [33,34]. These abilities are summarized in learning through probing-prompting learning models based on Belu cultural artefacts. This is also a sign with Vygotsky that learning in a socio-cultural environment through action and communication will gain competence. In the learning activities asking, observing, discussing, and communicating in the probing-prompting learning model student competencies related to mathematical communication skills can be grown and improved [35–38].

4. Conclusion
From the results of the study, it can be concluded that the students’ mathematical communication skills increase by applying a probing-prompting learning model based on Belu culture artefacts. All aspects of mathematical communication skills: grammar competence, discourse competence, sociolinguistic competence, and strategic competence are increasing from the first cycle to the second cycle. Some suggestion is given to a student to improve learning outcomes by always being active in learning activities. For teachers to design others learning activities using this learning model-based on Belu culture artefact.

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