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08.00 – 08.45	**Plenary Session 5** **Prof. Christa Kaune** (Institut für Koginitive Mathematik, Universität Osnabrück, Germany) Title: *Development of Metacognitive and Discursive Activities in Indonesian Maths Teaching (A Theory Based Analysis of Communication Processes)*	Auditorium	MC Moderator: Prof. Dr Zulkardi
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CHALLENGING NATIONAL MATHEMATICS EDUCATION TO PARTICIPATE IN CHARACTER DEVELOPMENT

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Abstract

In modern times, the quality of human resources that exist in a country has a very important value. In addition to having adequate knowledge and skills, the character owned a significant value in ensuring the knowledge and expertise can be used to maximum for positive purposes. Nowadays various science disciplines in the country are competing to develop themselves in order to participate in the development of national character. Mathematics is often regarded as a science that is not related to the character issue. Mathematics teachers in many of our national schools do not even understand how to link this lesson with the issues of character and so forth.

Despite all the facts occurred in our country, mathematics is actually a very important lesson that relates to humans and therefore would also affect the character of students who have experienced in this lesson either positively or negatively. In this paper researcher examines the various possibilities to involve mathematics education in the development of the character, Methods such as humanistic mathematics are actually believed to have positive contribution in this matter, but can this be applied in mathematics education in our country and what are the difficulties to do this? This paper examines the possibilities to really place mathematics in this position but still maintain its value. The final results showed that mathematics education delivered in a good, precise and cautious way can develop positive character traits that will affect student success both in the workplace and everyday life.

Key Words: Character, national mathematics education, humanistic mathematics, teachers, students.

I. INTRODUCTION

In this modern era all countries around the world are more active to carry out the development. Improvement in economic, health, infrastructure and all of the development agenda requires qualified human resources as the main power of development. One of the most interesting fact about past human resources development that has been done in many countries around the world is that the focus of of human resources development is solely on providing knowledge and skills with less attention on human characters. Human resources with good knowledge and skills but with less quality of character are indicated to be unable to fully utilize their knowledge and skills for positive purpose. This fact has been recognized by many education experts who have stepped up to voice reconciliation act in education toward education that began to work on positive character of students. This also happens in Indonesia, especially in various social science subjects that are directed to no longer focus on memorizing the

material but on the students understanding which are expected to form a self understanding that leads to the cultivation of positive values and the creation of a better character. Although this act is still in its early stages, but the seriousness shown gives hope for change in education. How about mathematics? During this time, many regarded mathematics as a science that does not relate to student characters but is more concerned with issues of intelligence and ability to solve mathematical problems. This may be seen quite clearly in mathematics education in many educational institutions in the country.

This paper aims to discuss these issues and search for possibilities to make mathematics to be involved in nation character development. Researcher is also try to examines lessons from countries that have already tried to apply the mathematics that is conected with the development of characters such as humanistic mathematics associated with other scientific discipline, how is the situation and condition o the application, what problems or difficulties that may occur in teaching math that are conected with character development and what positive lessons can be obtained from it. The results obtained are expected to contribute in encouraging national mathematics education to participate in developing the nation's character and to support the success of development goals in the country.

II. DISCUSSION (EXPLANATION)

A. Mathematics, Mathematics Problems and Character

The word mathematics originates from the Greek words *mathema*, which means learning, study or science. Mathematics is a study that has been developed since the days of old. Rudman (2007:64) states that there is evidence of counting since around 50,000 BC and in 10,000 BC the concept of division is found. Originally mathematics used in barter activity and measurement of various objects such as land, buildings, etc. At around 2000-1900 BC great civilizations such as Egypt and Babylon were known to have developed the mathematics to a higher level than ever before and began to used mathematics for financial purposes and development. The creation of mathematics derived from human need for a measurement and calculation on the process and activities of life. This gives more value to the mathematics and in the history mathematics is often regarded as a science that is higher than other sciences. From the

beneficial side mathematics has proved in its history to be a very useful science and can be used in many applications in various fields of work and life.

Mathematics does have its own uniqueness when compared with other science which is used to involve higher-order thinking processes in delivering this subject to students. Other science beside mathematics requires extra regulation and planning in advance if it needs to be delivered by using higher-order thinking processes. This has become an advantageous side of math but also causing problems for math. Mathematics is often viewed as a lesson that is difficult and feared by students. Latterell (2005:23) states that there are millions of people who experience anxiety in mathematics and it is portrayed as a negative reaction, the reaction of mental, emotional reactions, and/or physical reaction to the various processes of thinking and methods of solving math problems where this is often caused by a variety of negative experiences with mathematics during childhood or early adulthood. Furthermore Latterell (2005:23) call this math phobia, fear of mathematics and if a child has this condition it will prevent them to be willing and to be able to learn mathematics.

The uniqueness of mathematics that uses high-level thinking processes is not the sole cause of mathematics being considered difficult. Other cause considered by many experts as a more serious cause is how math is delivered to students. Many countries try to solve this problem in its history and consequently there are various methods which in turn are used to teach mathematics to students. There is a period when the math teacher did not explain the rules of mathematics but rather encourage students to think creatively and find the mathematical rules. The method in this period was later canceled because it was considered too difficult for students and there is a problem the lack of experience of teachers that are too excessive in encouraging students to find answers without giving guidance. Another period marked by teachers start to gave a variety of guidance and teaching theories are teached, but math is taught in the use of many symbols. This period was marked by the emergence of fear math because students also experience difficultness. Indeed, in principle, in this case it looks like mathematics teacher is being disgenerous to their students so that when they deliver mathematics to students they continue to use symbols that may be poorly understood by the students. This is probably can be understandable because math is a lesson that is not designed to be memorized only and many educators consider mathematics are not supposed to be

delivered like other lessons but still contains statements and questions which in this period may be described in terms of the symbol. Ohio Department of Education (1980:5) for example states that mathematical problem has four elements:

- A situation which involves an initial state and a goal state.
- The situation must involve mathematics.
- A person must desire a solution.
- There must be some blockage between the given and desired states

Relating to this matter of course in mathematical problem there must be clear separation or blockage between the given and desired states to create challenges that must be solved in mathematics, but this will become problems for students if the challenges given are considered too difficult which weaken point number three about motivation. This is what might be a lot of consideration in this period.

After that there are various periods and methods that were used to improve learning outcomes of mathematics, of course, these methods along with its advantageous and disadvantageous of each. In our country, these methods may also be used in any math either individually or in a combination of existing methods. If we remember the way to teach mathematics is struggling around the methods alone. From this one math problem arise. As we know every individual might have so many differences one from another. Each person has its own advantages and disadvantages. Each person has its own intelligence which it means the teaching of mathematics that has been used all this time that stays in one method might be beneficial to one student and being too difficult for another depends on what kind of intelligences do the student have. This means it can be assumed that the students who have been considered 'not good' in mathematics might have the opportunity to become more motivated, excited, and to be ‘good’ in mathematics if we delivered math sucject through other learning methods, the methods which play in the student strong point, methods which might not be familiar and rarely used by mathematics educators in general, which creating a situation that remained from the first until now is that there are students who are smart in math and there are students who are ‘dumb’ in mathematics.

Another problems mathematics become less liked by many people is the image of mathematics itself in the eyes of the media and public. Mathematical science is seen as being mastered by people who are not normal. Out of nowhere the origins of this view

but this has been around since then and the more visible and firmly planted in everyone's mind along with the increasingly sophisticated world of media. Latterell and Wilson (2004:2-12) who observed a variety of media such as magazines, novels, comic television, cinema, etc. states that in general mathematicians portrayed in such media as people who are not attractive, socially inept, genius, and even insane. Students who have difficulties in mathematics portrayed in the media as a normal student who have normal life while students thet is good with mathematician portrayed in the media as students who are abnormal. Furthermore Latterell and Wilson (2004:12) states that all activities in addition to mathematics, such as eating, interested in the arts, etc. is portrayed in the media as normal human beings activities while performing on mathematics is described as unusual activities performed by humans that are not normal. This media is consumed by the students and form its own view of what if someone would like to be smart in math. Proficiency in math is not something they want. Being a famous sports athlete is what they dream, becoming a doctor, actors, singers, businessmen, presidents, soldiers, and many more are the things that they see great and they want it as long as not become a mathematician. Finally this becomes an obstruction to create mathematics education that is liked by the students.

Seeing all the above events we must have been recognized and there is no doubt that mathematics is a science that is very helpful and useful in life but to develop mathematics for all, mathematics that can be used by all people it still need a long process. Mathematics needs to overcome all the problems that caused this lesson is less favored and a burden for many people.

On the other hand mathematics required to prove that in addition to its unique advantages and can also be preferred and mastered by everyone. In this country and internationally for example when the education world is heavily promoting the development of character, we should strive to develop the teaching of mathematics to participate in the character development effort as well. In this case, many argue that math is less relevant to the development of human character and more leaning towards the development of human intelligence. This is the more visible of the many educators who feel that this lesson have nothing to do with character and do not know how to develop students' character through this lesson. But of course this needs to be explored further. In education context, McBrien and Brand (1997:17-18) said that the word

character usually refer to how 'good' is someone. In other words if someone has personal quality that is the same/similar with personal quality demanded by society, this person will be assumed as someone with good character. The development of these personal qualities usually viewed as the goals of education. Darling-Hammond dan Bransford (2005), said that a learner's characteristic includes aspects of knowledge, skill, motivation, and attitude. It clearly describes educator's responsibility to shape the students.

The aspects of knowledge and skills are usually automatically attached to mathematics but what about the motivation and attitude aspects? If mathematics is feared by some students, then how can mathematics lead to motivation and attitude? Of course, various mathematical problems that have been discussed above need to be solved and the form of more exciting math that can be mastered by all students need to be shaped. One method that is discussed in the next section is the humanistic mathematics in the next section, but all this must be accompanied with a belief that mathematics is a science that proved useful and necessary to be mastered by students to support life their and that is all students need to have the opportunity to master this subject and in the process of mathematics is able to form a positive character in students, especially the courage and creativity.

B. Humanistic Mathematics

Humanistic Mathematics is an approach to mathematics education delivery by combining it with other disciplines. Generally the purpose of mathematics humanistic approach is first to try to resolve the problems of many students' difficulties in learning and understanding mathematics and the second to bring mathematics closer to the real world and in giving contribution to solve various problems that may arise in the workplace and daily life.

National Council of Teachers of Mathematics (1989:149) in Brown (2002:12) reveals several lists of mathematical connection with other various disipline:

- *Art:* the use of symmetry, perspective, spatial representations, and patterns (including fractals) to create original artistic works.
- *Biology:* the use of scaling to identify limiting factors on the growth of various organisms.
- *Business:* the optimization of a communication network.

- *Industrial arts:* the use of mathematics-based computer-aided design in producing scale drawings or models of three-dimensional objects such as houses.
- *Medicine:* modeling an inoculation plan to eliminate an infectious disease.
- *Physics*: the use of vectors to address problems involving forces.

Other areas that can be combined with the mathematics in humanistic mathematics for example are psychology, history education, language, philosophy and even poetry, etc. The relationship of mathematics with other fields can take place in two forms in accordance with the general purpose. First, other fields/disciplines outside mathematics are used to support mathematics education. This will make mathematics being delivered to students better; mathematics might be more exiciting to learn; and can be learned deeper and more comprehensive. In this case other disiplines serves as supporters of mathematics and the humanistic aspects of mathematics can be seen from the flexibility of mathematical to be delivered by various media. Second, mathematics is used to help a variety of other fields/disciplines in resolving various problems as seen in previous examples. In this case mathematics is used as a supporter of other disciplines and the humanistic aspects of mathematics in this case can be seen from the capability and concern of mathematics in participating and solving various real life problems. Some peoples view this function as applied mathematics and with humanistic mathematics this application might be developed further.

Discussing the use of various other disciplines such as history, art, etc. is actually able to improve some students' motivation and interest. It may be fun to see students' reactions when they finds out that for example the theory of Pythagoras that they learned is actually proved to be a very old theory that was invented by Pythagoras in about 518 BC.

Moreover, if talking about how this theory was developed and what may be considered or thought by the scientists at the time. Another interesting example is maybe by showing Napier’s Bone calculators that is used in the past to facilitate the counting process that may not be widely known by students. Regarding the use of history in mathematics, Brown (2002:8) argues that when connecting with the history of mathematics even when we cannot produce evidence for how it is that an idea evolved, we can ask a hypothetical historical-type question: *How might this idea have evolved?* This certainly might encourage students to think critically and begin to learn to make

specific hypotheses and unknowingly may make them a step closer to like math. In the use of the arts such as the use of poetry, song, two-dimensional picture, three-dimensional picture, abstracts, etc. can also motivate and attract students and further it might even lighten the burden of students in learning mathematics. The main ideas of this humanistic mathematics use is to make mathematics more humanistic, making mathematics into a form of science that is more likely capable to be mastered and understood by different students not just certain students with specific abilities that luckily match with math lessons. If it is successfully implemented it will improve the position of mathematics as a science that gives its contribution in improving the quality of human life.

This can also be done by expanding the possible use of mathematics in various fields such as discussed above and it might be possible to increase the motivation of students in math if they know that mathematics is indeed important and will be very useful for their future lives. Mathematical indeed is an interestng subject and many experts said that mathematics might be able to make us know why a boat can float on water, why airplanes can fly in the air, and so on. The issue is whether mathematics has been presented and delivered in that ways, interesting as it should. This further increases the importance of delivering math better and may be in a more realistic way.

Humanistic Mathematics is also makes mathematics broader because students can express his thoughts and give its contribution in the development of this science.Brown (2001:95) stated that It is not only interesting for diagnostic purposes to find out what a student thinks a unit or a field of inquiry is about. Rather, a class record of its perception regarding the nature of a topic being studied for several weeks, months, or even an entire semester would reveal not only how students see what it is all about in some general sense, but how their viewpoint relates to the problems they entertain. he said that it would be valuable to record dissenting opinions as well as popularly held points of view. It would also be enlightening to see how and why perceptions change over time. This in turn might not only leads to motivation and courage but also creativity, critical attitude, and more realistic intelligence.

C. Humanistic Mathematics, Problems and Possible Application in Mathematics Education in Indonesia

One important aspect in applying the humanistic mathematics approach to the national mathematics education is how to convince teachers that math can indeed be associated with and affect the character of students. So far, most teachers assume that math lesson had nothing to do with the problem of values, norms or character. The character development efforts in this country are usually delivered through subjects such as PPKN (humanities and nation ideology), government science, culture science, etc. New educational era that encourages various different disciplines to participate in the development of character requires an understanding from the teachers. Teachers view that math is not related to characters need to get in-depth briefings and discussions to find an agreement and participation of all parties.

The next step is that the educators also need to gain knowledge and be convinced that this approach can bring a positive impact. In this stage we need to create awareness and empathy of the educators that they too can contribute and participate in the development of national character and this is very important for the welfare of the nation. Educators also need to get the understanding that the application of humanistic mathematics on one side can bring positive effect for character development and on the other hand may be able to solve the problems they face all this time in helping students who struggle in mathematics lessons, students who are not motivated and even fear math by providing a variety of broader alternatives in delivering math to students.

Another thing that needs to get serious attention is that although humanistic mathematics has been widely discussed as one important step in providing a more realistic mathematics lessons and to bring students to an understanding of the mathematics that is more profound, but the application of humanistic mathematics education at national level is not easy. Lang (2004:4) for example observes the experiences of other countries in conducting this reconciliation in mathematics education and the result he finds was the reconciliation was not going well. This occurs because although there was many new breakthroughs being found in mathematics teaching approaches there is still much lack of clarity and inconsistencies in the messages being delivered and These inconsistencies will most likely permit teachers to choose what is familiar to them - the meaningless “traditional” content and pedagogy because they have not personally experienced any other approach. The teachers feel that they have not experienced in running approaches other than traditional approaches. This

happened repeatedly and the effect is many notions arise that humanistic mathematics is difficult to apply and the better way is to return to traditional 'way.

From these experiences there is a lesson that can be drawn that in order to implement a good humanistic mathematics at all educational institutions at the national level careful and serious planning are needed and this includes taking account of the readiness of educators. Mathematics teachers need to receive specialized training for this new approach to execute the approach perfectly. Of course keep in mind that generally mathematics teachers should have good skills in solving mathematical problems and in deliver the subjects to students but there is also the fact that most of the mathematics teachers allegedly still do not have the ability to perform humanistic approach and this is normally beyond their basic skills.

Another difficulty which may arise from the application of humanistic mathematics is how to combine mathematics with other disciplines without losing the identity of the mathematics itself. Various mathematicians expressed the need for caution in connecting mathematics with other disciplines. For example, in connecting mathematics with history if not careful, it can only be pure history lesson which is much distorted from the initial goals. The proportion of combining different knowledge without losing iitial goals is very important. Moreover, it there can be extreme differences between the two sciences that will be combined. There can be differences in pure mathematics and real-world mathematics for example the difference of Phytagoras calculation and taxicab geometry calculations (Krause, 1986), differences in qualitative and quantitative research, etc. Finally, we need to have careful planning including the right curriculum planning involving math educators and teachers of other disciplines to sit down together and create the right situation for humanistic mathematics application real including the planning of time needed for the lessons that is sufficient to deliver a good humanistic mathematics.

Implementation of humanistic mathematics in order to support character education in Indonesia is a good and usefull idea but from the start of implication till the desired results to be gained certainly requires time and long process especially in changing the system, habit, mindset, etc. However, given the importance of character for the sake of nation, efforts to achieve mathematics that participate in character development need to be continuously pursued.

III. CONCLUSIONS AND SUGGESTIONS

- Human resources are the main drivers of national development and the character of these human resources has an important value that is equal with knowledge and skills. Mathematics is connected with student's character development and can be maximized in order to participate in the development of national character. In order to do this mathematics can not be delivered through general and traditional method and require a special approach. The approach of humanistic mathematics is capable to bring mathematics education to achieve good character development and need to be developed in our country.
- Humanistic mathematics application in this country might face difficulties and obstacles such as insufficient understanding from teachers about the connectivity of mathematics and character development; doubt from teachers that humanistic mathematics will bring positive effect and have more benefits than traditional approach; limited teachers' ability and experience in executing the humanistic approach to mathematics educcation; possibilities of inconsistencies in education system reconciliation; and difficulties in combining two or more disciplines that may have different principles. These problems needs to be solved first by providing understanding to teachers and socialize the benefits of humanistic mathematics that is not only to develop students' character but also to have better assurance in all student proficiency in math. Teachers also need to acquire special training in order to execute humanistic mathematics and there is an importance of a well designed planning in order to apply humanistic mathematics in this country including curriculum design that involved teachers from discipline of mathemathics and other disciplines as well.
- Although this method is seen as a promising one but the implementation and application of this method require enough time, effort and funds. Commitment and serious attention from all parties are required to promote mathematics to reach a higher level and meet the challenge to participate in national character development.

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