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Promoting the Pancasila Students' Profiles through Mathematics Education in Schools: Ethnomathematics Roles

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Abstract: Promoting the Pancasila Students' Profiles through Mathematics Education in Schools: Ethnomathematics Roles. The present mathematics curriculum in Indonesia (IND) places a strong emphasis on the creation of a Pancasila student profile in order to ensure that pupils are learning mathematics in a meaningful way. **Objective:** This paper suggests an integration of ethnomathematics into the formal mathematics curriculum as one approach to dealing with these learning issues. It is based on a literature assessment of studies on ethnomathematics, mathematics education, and Pancasila student profile. **Methods:** The literature review method used with a narrative review design. A total of 28 articles were selected for publication at the final stage of the review process. **Findings:** In light of the preceding explanation, it is clear that ethnomathematics plays a part in the formal school mathematics curriculum since the context-relevant and constraint-filled problem-solving techniques give many abstract mathematical notions the required contextual meaning.

Keywords: ethnomathematics, mathematics education, pancasila student profiles.

Abstrak: Mendorong Profil Siswa Pancasila melalui Pendidikan Pendidikan Matematika di Sekolah: Peran-Peran Etnomatematika. *Kurikulum matematika di Indonesia saat ini memberikan penekanan yang kuat pada penciptaan Profil Pelajar Pancasila untuk memastikan bahwa siswa belajar matematika dengan cara yang bermakna.* ***Tujuan:*** *Artikel ini menawarkan integrasi ethnomathematics ke dalam kurikulum matematika formal sebagai salah satu pendekatan untuk menangani masalah pembelajaran. Hal ini didasarkan pada kajian literatur studi tentang ethnomathematics dalam pendidikan matematika, dan Profil Pelajar Pancasila.* ***Metode:*** *Metode kajian literatur digunakan dengan desain kajian naratif. Sebanyak 28 artikel dipilih untuk diterbitkan pada tahap akhir proses peninjauan.* ***Temuan:*** *Berdasarkan temuan dan penjelasan, maka jelas bahwa ethnomathematics dapat berperan dalam kurikulum matematika sekolah formal karena teknik pemecahan masalah yang relevan dengan konteks dan permasalahan memberikan banyak gagasan matematika abstrak berdasarkan makna kontekstual.*

Kata kunci: *ethnomathematics, pendidikan matematika, profil pelajar pancasila.*

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INTRODUCTION

The globalization-era process of modernizing the country's lifestyle has significantly contributed to the decline of Indonesian culture's high ideals (Hidayat & Pandin, 2021). It occurs due to a lack of understanding and implementing cultural values in the community. Every person needs to be imbued with the fundamental values of the country (Emilia, Andini, & Asbari, 2022). So that each person can better understand, interpret, enjoy, and grasp the value of carrying out every life activity, it needs to be imparted from an early age. Cultural values can be fostered through the family unit, the educational system, and the community (Agus, Cahyanti, Widodo, Yulia, & Rochmiyati, 2020).

The ease of access to a variety of knowledge that has no time or space limits, but is misused, is one of the reasons why cultural values are eroding among today's kids (Supiarza, Rachmawanti, & Gunawan, 2020). Technology use expertise is frequently abused, making complexity into a sharp, two-edged tool that, in addition to being functional, is frequently utilized to produce losses through losses-causing harm. Technology indirectly affects schooling, as untested media and information may be perceived as role models to be adopted and used (Skare & Soriano, 2021). Despite the reality that technology cannot replace the teacher's position as a learning resource for pupils (Jain, Lall, & Singh, 2021), it appears that technology has taken its place. No matter how advanced technology becomes, it will never have a soul. The teacher is a role model who supports students' cognitive and moral maturity growth (Ahn, Hu, & Vega, 2020). While it can aid instructors in the teaching process, technology in education can never fully replace them. Despite the fact that this phenomenon has been investigated, it is still worthwhile to conduct additional research regarding it, which ties to how culture changes as technology advances, mainly the function of information and communication technology as a platform for a wide range of activities and knowledge sources.

People appear to be pampered by the ease of information and communication technology has made all of their demands accessible. The majority of today's user society has started to leave interpersonal communication patterns and become less and less willing to use manual tools for effectiveness and efficiency reasons (Pouri & Hilty, 2021). It gets harder and harder to stay sophisticated in society. People will become increasingly dependent due to this for a very long period. Long-lasting things bring about cultural changes in society (Peregrine, 2022). For instance, using social networking or friendship on the internet is frequently regarded as a barometer for one's existence.

Both the constructive and destructive sides of change are inherent. It is impossible to avoid changes in systems and standards. When technology is employed ethically, professionally, and with integrity, constructive change occurs. Because of this disturbance, the government has responded with various regulations, including ones for education. According to the Indonesian Ministry of Education and Culture's strategic plan for 2020–2024, Pancasila Students (PP) will help the president realize his goal of becoming independent, sovereign, and unique education and country (Zakso, Agung, Sofyatiningrum, & Capnary, 2022). Students are expected to think critically, creatively, and independently, have confidence in God Almighty, fear Him, have a noble character, cooperate, and be culturally diverse.

Additionally, it takes on the persona of a lifelong learner who embodies Pancasila's values and is globally competent. Faith, the awe of God Almighty and noble character, cooperation, independence, critical thinking, and creativity make up the six main traits (Nurhayati, Jamaris,

& Sufyarma Marsidin, 2022). The development of Profile of PP must function at its best for students to be involved in all aspects of learning, including studying math.

A formal procedure with normative and dogmatic rules that are disconnected from the socio-cultural realities of society is frequently used to study mathematics (Zhang et al., 2020). In the meantime, the display and debate processes in mathematics learning did not appear or grow. Only the teacher-to-student transmission of knowledge constitutes mathematics learning. Without critically assessing what they have learned, students merely take mathematical knowledge as given. As a result of pupils' inability to comprehend mathematics, learning it feels pointless (Prahmana & Ambrosio, 2020). As a result, they cannot apply their knowledge of mathematics to real-world issues.

A significant challenge in understanding mathematics is the transformation of cognitive abilities from concrete to abstract items or the opposite (Venenciano, Yagi, & Zenigami, 2021). Therefore, it is essential to increase the significance of mathematics in daily life. The pressing necessity to advance mathematics' position demonstrates that it is a crucial piece of the knowledge base required for educational growth. The growth of mathematics is a component of the scientific foundation of knowledge and is inextricably linked to cultural shifts (Liu, He, & Dai, 2021). According to another viewpoint, the knowledge of a culture that expands and develops to link human needs makes mathematics what it is.

The review of human development, especially in the fields of science, shows that mathematics is related to many human efforts to acquire knowledge (Krumrei-Mancuso, Haggard, LaBouff, & Rowatt, 2020). Meanwhile, the value of mathematics related to the nature of mathematics is derived from how mathematicians from different cultures develop mathematics. These two views lead to the conclusion that mathematics and culture are inseparable parts. The coherence between cultural anthropology, mathematics, and mathematical modeling is referred to as ethnomathematics.

A nation will be great if cultural values are ingrained in the bones of human existence (Banks & O'Connor, 2021). Hence culture has a fundamental and necessary role as the foundation of the life of the nation and state. Since the reformation up till the present, Indonesian culture has faced numerous significant difficulties, particularly for the younger generation, who have struggled to understand the local culture. The majority of them are not very interested in regional culture. Therefore, it is important to keep expressing cultural discourse, particularly about high ideals. One way to do this is to uphold, advance, and expand the archipelago's cultural values while internalizing them through academic study.

This study seeks to draw attention to the fact that everyone working in the education services industry needs to deal with this issue head-on since doing otherwise could result in several adverse outcomes. This study makes the point that math teachers' classroom techniques significantly impact students' capacity to learn mathematics and student character development, despite the fact that many other elements could have led to math learning becoming meaningless.

The success of the educational reform in Indonesia depends on changing the culture of mathematics instruction, which this article suggests should happen in light of the ongoing educational reform in Indonesia. Masingila (1993) identifies three areas of mathematics education that need attention in light of the study on carpet layers and other studies that look at how math is used in real-world contexts. These

include the following: (1) the mathematics education research, (2) the methods used to teach mathematics in schools, and (3) the curriculum for math classes. This essay seeks to offer some ideas for thought under the following sub-headings while covering the last two themes.

1. Defining the role of ethnomathematics in mathematics education.
2. A Promising Direction related to the Ethnomathematics: Trivium Curriculum
3. The Role of Mathematics Education in the Development of Profiles of PP

METHODS

This study uses the literature review method with a narrative review design. The narrative review summarizes studies on a subject of concern previously published, concentrating on concepts and hypotheses, methods of study, or findings of the research (Paré, Trudel, Jaana, & Kitsiou, 2015). The most significant elements of the research are the compilation and synthesis of existing literature and a full report on recent expertise in the field under study. The narrative examination also serves as a suitable starting point for potential research and development and allows researchers to define and refine questions or theories in research. The source of this research data is in the form of secondary documents obtained from relevant scientific journals.

Conducting the Review

Two categories of keywords were used separately to search for relevant literature sources using keywords: (1) ("Pancasila Student Profile" AND "Mathematics Education") in Google Scholar; and (2) ("Ethnomathematics" AND "Mathematics Education" OR "Mathematics Learning" OR "Mathematics Teaching") in Scopus and ERIC databases.

The first keyword resulted in 155 titles appearing. The manual screening was carried throughout titles and abstracts relevant to the study and excluded data sourced from proceedings and non-accredited journals Sinta 1 – Sinta 4. For the second keyword, the search referred to the Preferred Reporting Items for Systematic Review standard and Meta-Analyses (PRISMA) to offer a comprehensive picture of the justification of the ethnomathematics approach in learning mathematics. The elements of the PRISMA standard include identification, screening, eligibility, and inclusion.

The first step is identification, that is, searching for articles with the keywords "Ethnomathematics" AND "Mathematics Education" OR "Mathematics Learning" OR "Mathematics Teaching" in the Scopus and Eric database. It was recorded that 208 articles appeared in the Scopus (n=145) and Eric (n=63) databases.

The second step was screening, which consisted of (1) manual screening (title and abstract); 203 papers were identified as meeting the research criteria, while five articles were identified as duplicates; (2) applying the inclusion criteria and leaving 35 articles. We established exclusion criteria for various document categories: conference proceedings, books, book reviews, magazines, short surveys, short communications, correspondences, newsletters, discussions, product reviews, editorials, publisher's notes, and erratum.

In the third step, eligibility, 11 articles were rejected at this step because they needed to fully explain ethnomathematics in mathematics education or clearly explain and review the finding data in the research findings section.

In the Inclusion step, only articles that match the following inclusion requirements were selected: (1) Discussing ethnomathematics in learning mathematics; (2) Registered in Scopus or ERIC databases (for indexing and citation quality); (3) Written in English. As a result, 24

articles were selected for publication at the final stage of the review process.

■ RESULTS AND DISCUSSION

Defining The Role of Ethnomathematics in Mathematics Education

Some research (e.g. Harding, 2021; Nur et al., 2020; Pathuddin & Nawawi, 2021; Prahmana & Istiandaru, 2021; Supiyati et al., 2019) has demonstrated substantial differences between the kinds of mathematical practices people in various cultures engage in daily and those taught in schools. Particularly Masingila (1993) emphasizes how knowledge of mathematics "gained in our out-of-school situations often develops out of activities which: (1) occur in a familiar setting, (2) are dilemma driven, (3) are goal-directed, (4) use the learner's natural language, and (5) often occur in an apprenticeship situation allowing for observation of the skill and thinking involved in expert performance." This is not how mathematics is taught in schools.

The term "ethnomathematics" refers to the study of mathematical concepts, strategies, and procedures used and generated by members of various cultural groups or sociocultural individuals (D'Ambrosio, 2016). Lexically, the *ethno* prefix, *tics* suffix, and *mathema* as the main subject are employed to create the meaning of ethnomathematics (Umbara, Wahyudin, & Prabawanto, 2021). The *ethno* prefix is a very general term that refers to the sociocultural context (including language, jargon, code, behavior, myths, and symbols), identification of cultural groups, and specific ways of reasoning and certain inferences. It is made up of elements from nature, society, culture, and imagined environments. The core concept of ethnomathematics is mathematical objects. Lexemes frequently have definitions like "explaining," "knowing," "understanding," and "doing tasks" (such as coding, classification, measurement, planning, inference and modeling). In the same way art, fashion, style, and technique have technical roots, so do suffix *tics* (D'Ambrosio, 2018).

Suppose the definition of ethnomathematics includes both the cultural or everyday practices of mathematics of a particular cultural group and a program that examines the generation, transmission, institutionalization, and diffusion of knowledge with a focus on the sociocultural environment. In that case, ethnomathematics has a place in the context of the teaching and learning process in the formal classroom (Machaba & Dhlamini, 2021). This is so that the teaching of the related but abstract concepts found in school mathematics can be connected to the everyday cultural practices of mathematics (Supiyati et al., 2019). Ethnomathematics is both context-relevant and problem-specific, and as a result, it provides the required connectivity between these two. Additionally, it can help students understand the significance of the links between ethnomathematics and school mathematics and give many of the abstract mathematical concepts they are taught in class a meaningful context, thereby validating the importance of school mathematics (Sunzuma & Maharaj, 2020).

Researchers are interested in exploring mathematical concepts that are used by numerous social groups, which has piqued their interest in the research genre of ethnomathematics in mathematics and mathematics education (Arisetyawan, Suryadi, Herman, & Rahmat, 2014; Hendriyanto, Kusmayadi, & Fitriana, 2021; Orey & Rosa, 2021; Prahmana & Ambrosio, 2020; Prahmana, Yunianto, Rosa, & Orey, 2021; Suharta, Sudiarta, & Astawa, 2017; Supriadi, 2019). As the founder of ethnomathematics, D'Ambrosio (2016) demonstrated that one important justification for teaching mathematics on an

ethnomathematics basis is the idea that mathematics is a manifestation of the evolution of culture and human thought. Building on the ethnomathematical knowledge that students bring to class from their everyday experiences, making appropriate connections between this and school mathematics, and elucidating the conceptual meanings associated with abstract school mathematical ideas are all tasks that the classroom teacher must complete. The ethnomathematical information that students have acquired from real-world experiences—knowledge they have also come to feel ownership over—will be formalized through such a teaching strategy.

For instance, Figure 1 depicts an illustration of an ethnomathematics activity at IND that can be utilized to clarify the geometric idea of "Riemann's triangle theorem" (Kholid, Fitriana, Adnan, Hendriyanto, & Sahara, 2022).

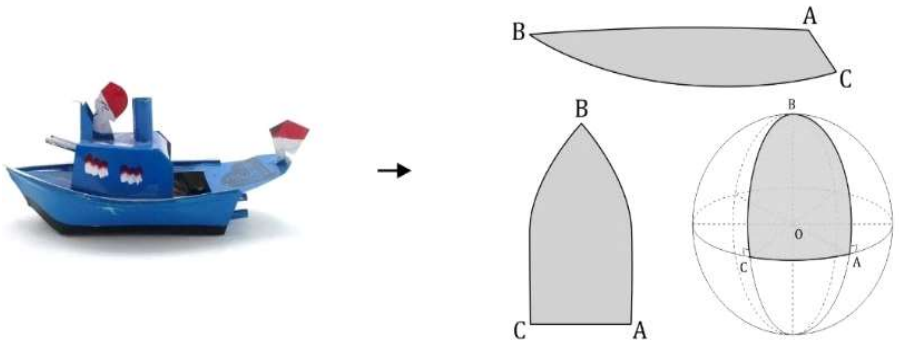

Figure 1. *Perahu othok-othok* and its illustration in the Riemann triangle

The illustration of *perahu othok-othok* in Figure 1 above can explain the Riemann triangle theorem "the sum of the angles of a triangle is higher than 180^o". Figure 1 above shows $\angle A = 90^o$ if the segment BC = polar distance. Identified information: $\angle A = 90^o$, $\angle C = 90^o$, $\angle B$ positive. Hence, $\angle A + \angle B + \angle C = 90^o + \angle B + 90^o > 180^o$. It is one of the many well-known examples that may be used to teach various formal geometrical principles in school mathematics and further explored for its deeper mathematical insights frequently sought in academic mathematics. In the context of mathematics training in schools, however, it makes the study of mathematics more interesting and pertinent by giving the students even more reasons to learn mathematics. Thus, it becomes imperative to incorporate ethnomathematics into the teaching of mathematics.

A Promising Direction related to the Ethnomathematics: Trivium Curriculum

The trivium curriculum for mathematics proposed by D'Ambrosio (1999) is an important innovative ethnomathematics approach that needs more investigation in order to address pedagogical purposes. Since ethnomathematics proposes that educators contextualize their mathematics teaching and learning by linking mathematics content to students' sociocultural experiences, integrating culturally relevant pedagogy and diverse ethnomathematics perspectives into existing teacher education programs became necessary.

The four goals of mathematics education, the goal relevant to ethnomathematics is the cultural goal. The purpose of culture in education is a form and product of culture. Mathematics education needs to place mathematics as a result of human culture and

simultaneously as a process to develop a culture (Planas, 2018). In connection with the cultural goals of mathematics education, mathematics education can be used as a tool for forming in and for life (Presmeg, 1998). We can use mathematics to understand and solve problems that are found and faced in everyday life.

One of the first requirements for the current mathematics curriculum is that it be flexible enough (Tirosh & Tsamir, 2020; Trouche, 2020) to accommodate the ethnomathematical knowledge gained from everyday practices of mathematics that students bring into the mathematics classroom to accommodate the potential role of ethnomathematics in the teaching of school mathematics. D'Ambrosio (1999) once developed a trivium curriculum, which consists of literacy, *matheracy*, and technocracy, allowing it to be developed in school activities.

Literacy is the ability of students to process, write, represent, calculate, and use various media and the internet. From a mathematical perspective, literacy is defined as the integration between the cultural context in the school and the cultural context in society through cultural dynamics that allows students to exchange academic knowledge and local knowledge. From the modeling perspective, educators must guide students to choose topics through dialogue and discussion that allow students to engage in mathematical exploration and creativity.

Matheracy is the ability of students to interpret and analyze signs and codes to propose a model to find solutions to everyday problems. This can help students develop creativity and analytical skills to understand and solve new problems and situations. From ethnomathematics perspective, *matheracy* is defined as a field of skills, strategies and competencies that trigger students to be aware of their way of explaining traditional beliefs, myths, symbols, scientific knowledge and mathematical knowledge. From a modeling perspective, *matheracy* is defined as the ability to interpret, manipulate, and recognize signs, symbols, and codes and use mathematical models in everyday life.

Technocracy is the ability of students to use and combine various technological instruments that help students in daily activities to assess the reasonableness of their results and contextualization. Technocracy is an important feature of scientific knowledge to translate matters related to the natural, social, cultural, political, and economic environment. The natural and social environment consists of various modes of explanation, belief, tradition, myth, and symbol in the development of mathematical knowledge. So, the perspective of modeling, technocracy is the combination and use of various tools, including calculators, computers, computational software programs and simulators.

The trivium curriculum critically provides education with the communicative, analytical, and technological instruments needed to develop education in the 21st century. Incorporating the three trivia in the classroom will imply a conceptualization in which ethnomathematics and mathematical modeling are tools for pedagogical action. In its development, this curriculum was adopted by several countries that developed ethnomathematics and studied further. Furthermore, it will facilitate the incorporation of diverse modes of explanation, belief, tradition, myth, and symbols in the development of mathematical knowledge. In the modeling process, technocracy is the incorporation and use of diverse tools that

include calculators, computers, software, computational programs, and simulators.

The Role of Mathematics Education in the Development of Profiles of PP

In improving the quality of education in Indonesia, the formal school curriculum has changed more than ten times since it was first created (Setiawan, 2020). The discourse of the latest curriculum, the "Merdeka Curriculum," which will be implemented nationally by all schools in Indonesia in 2024, has launched the profile of Pancasila students (PP). PP embodies Indonesian students as lifelong students who have global competence and act by the values of Pancasila (Hidayah, Suyitno, & Ali, 2021). Strengthening the profile of PP is a cross-disciplinary project from various subjects in the education unit. This project is carried out by adjusting the community's needs or problems in the school environment. Profile of PP has six key values: noble morals, global diversity, cooperation, independence, critical reasoning, creative (Fadillah, Wiwit, & Aisyah, 2022) and there are seven general themes in PP strengthening projects (Armania, Alfitri, & Dahlan, 2022). Ethnomathematics can facilitate five of the seven project themes: sustainable lifestyle, local wisdom, diversity in diversity, engineering and technology to build the Unitary State of the Republic of Indonesia (NKRI), and entrepreneurship.

The first is the sustainable lifestyle. This theme is intended to understand the impact of human activities, short and long-term, on the continuity of life in the world and the surrounding environment. The emphasis here is on building awareness to act and behave environmentally friendly and finding solutions to environmental problems. One of the forms of the culture studied in ethnomathematics is the activities of various cultural backgrounds, including the activities of "farmers." A study by Umbara et al., (2021) revealed that the Cigugur indigenous people in Kuningan Regency could predict what days were considered suitable for starting farming activities. This activity can be used to teach mathematics, such as the concept of numbers, sets, relations, congruence, modulo, and mathematical modeling.

The second is local wisdom. Indonesia is hit by the crisis of self-identity caused by the fading culture and local wisdom of the community. This theme was chosen to build curiosity and inquiry abilities by exploring the culture and local wisdom of the local community or area and its development. It is relevant to use ethnomathematics as a learning approach in mathematics lessons. In addition to teaching mathematical concepts, ethnomathematics also plays a role in introducing culture to students. Applying ethnomathematics as a pedagogical action in learning mathematics restores a sense of fun or involvement and can increase creativity in doing mathematics (D'Ambrósio, 2005; Prahmana & D'Ambrosio, 2020; Risdiyanti & Prahmana, 2021). Teaching mathematics, considering that mathematics is an expression of cultural development and human thought, is a relevant reason for teaching mathematics on an ethnomathematics basis (D'Ambrósio, 2005; D'Ambrosio & D'Ambrosio, 2013). Thus, learning mathematics needs to begin by using the real context of the sociocultural realities around students. Students' needs are not just learning external values and rigid academic mathematical knowledge (Prahmana, 2022).

The next is Unity in Diversity or Bhinneka Tunggal Ika in Indonesian terminology. Intolerance and radicalism have

become issues in the spotlight lately. Students must be invited to learn to build a respectful dialogue about the diversity of religious groups and beliefs held by local communities in Indonesia and the values of the teachings they adhere to. Studies focusing on the relationship between mathematics and culture allow one to reflect on different cultures and find ways to explore classroom challenges in classroom settings (Nkopodi & Mosimege, 2009). Through ethno-modelling, ethnomathematics ideas from different cultural groups can be a tool for teaching and learning school mathematics. It is assumed that the context students are familiar with is a powerful resource for teaching and learning mathematics.

We continue to the engineering and technology, which can indicate the advancement of the quality of a nation's human resources. Therefore, the implementation of engineering and technology continues to be encouraged so that students can collaborate in training critical, creative, and innovative thinking, as well as the ability to empathize with engineering to build technological products that facilitate their activities and those around them. Technocracy in the trivium curriculum developed by D'Ambrosio (1999) makes it possible to facilitate this topic. Technocracy is the ability of students to use and combine various technological instruments that help students in daily activities to assess the reasonableness of their results and contextualization.

The last theme is entrepreneurship. This theme is carried out in order to foster entrepreneurial souls in students. Students will later identify economic and business opportunities at the local level, problems in developing these potentials and business development, and their relation to environmental, social and community welfare aspects. Buying and selling activities carried out by the community can be used as learning content to raise this theme in ethnomathematics studies (Nurjanah, Mardia, & Turmudi, 2021).

Within decades, the dogma of the teacher as the authority and the only source of knowledge and information in the formal classroom (Hanif, Wijaya, & Winarno, 2019) developed massively in Indonesia. Many people believe this assumption because teachers consciously or unconsciously encourage this view. Evidence that teachers reinforce this view is shown by the absence of opportunities given to students to reflect and criticize what is being learned (Beene & Greer, 2021; Prahmana & Ambrosio, 2020; Zhang et al., 2020). The process of redefining the role of mathematics education requires teachers to see themselves as facilitators of the teaching and learning process, not as authorities and communicators of knowledge. In practice, this approach requires teachers to recognize students as equal partners in the teaching and learning process and encourage them to make meaningful contributions to educational activities. In other words, students become active participants in exchanging information and not passive recipients of information presentation.

If teachers can ensure that mathematics learning and mathematics education go well in schools, then ethnomathematics will become a bridge for students to understand the values imbued in learning mathematics. The six characteristics of PP will be realized through the development of Indonesian cultural values and Pancasila. With Indonesian cultural identity and Pancasila values that are deeply rooted, Indonesian society will become an open society with global citizenship - able to accept and utilize various sources, experiences and values

from various cultures. Thus, with optimal curriculum and implementation, ethnomathematics will assist in developing PP profiles via mathematics education.

n CONCLUSIONS

In light of the preceding explanation, it is clear that ethnomathematics plays a part in the formal school mathematics curriculum since the context-relevant and constraint-filled problem-solving techniques give many abstract mathematical notions the required contextual meaning. Mathematics teachers need to view themselves as facilitators of the teaching-learning process rather than as authorities and transmitters of knowledge to accommodate ethnomathematics' function in mathematics instruction. To achieve this, teachers must recognize students as active participants in the information-sharing process rather than passive recipients of information presentation and as equal partners in the teaching and learning process.

Utilizing students' extensive ethnomathematical knowledge in the classroom fosters the growth of conceptual understanding among pupils. Mathematics becomes a meaningful and reflective topic when pupils can create broad-ranging problem-solving procedures that necessitate both teachers and students to further test their validity in a variety of familiar and novel scenarios.

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