Internalizing Religious Values into Ethno-Mathematics as an Effort to Strengthen Character Building: An Ethno-Mathematics Integration Study

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Abstract: The undesirable fact of ignoring the cultural noble values in society inspired the emersion of mathematics basic concepts. Mathematics is always there to provide simple formulation when the society face problems in daily life. The existence of values in mathematics such as independent, critical, logical, and creative has implicitly shaped our national character. The heritages such as inscriptions, pyramids, religious sites and their ornament, calendar, batik, woven, weaving and so on are real examples of knowledge contribution including mathematics. Internalizing religious (Islamic) value was felt necessarily embellished into ethno-mathematics learning which includes the required value to develop the noble values and strengthen individual character in community, nation, and state life. This article aims to spread the ideas through illustrating the ethno-mathematics concept planting combined with the religious value as a step to build the character, the noble student individuals (*akhlakul karimah*) just as our hope.

1 INTRODUCTION

Some serious efforts have been done by the government as an independent and dignity nation shown by discussions, seminars, and symposium with main theme "strengthening character education". This is evidenced their curriculum changes every decade ranging curriculum 1974 to 2013. Various curriculum innovations have been carried out to fulfill and answer the challenges of times and generations in the future. This form of innovation has created a variety of distinctive features in providing answers to challenges at certain times, such as (i) an effort to motivate students actively in learning packaged in curriculum CBSA, (ii) an efforts to increase the competency of students nationally, then applied based curriculum competence, (iii) to foster the competency diversity and character of students locally, packed in the education unit level curriculum, and finally (iv) 2013 curriculum which emphasizes on strengthening character education. Alteration and renewal the curriculum above, indicates that the government is serious in facilitating potential development for future generations to the nation's dignity.

Harmonization of the heart (ethics), sense processing (aesthetics), thought-processing (logic-literacy), and physical/sports (kinesthetics) are efforts made to strengthen character education (Yunus, 2013). This harmonization involves the support of all elementer (school, families, and communities). Thus, it can achieve of the value of the character, such as religious attitude, honesty, tolerance, discipline, hard work, independent, creative, love of the homeland, communicative, friendly, caring, and responsibility. 2013 curriculum is focusing on the formation and development of the character/ morality students through strengthening character education program. The crystallization of value character above, include religious, nationalist, independent, cooperation (*gotong royong*), and integrity. Therefore, those notions are presented into teaching and learning which are integrated and connected with local wisdoms.

Mathematics subjects are still classified as popular subjects in school. Even public interest in mathematics remains one of the benchmarks for predicting one's intelligence and success in the future. Therefore, mathematicians and mathematical education experts try to present mathematics easily,

such as presented by many circles both in terms of composition, order of presentation of objects, concepts, principles, and procedures as well as in terms of the implementation of concepts, principles and procedures in answering any problems that arise.

Mathematical concepts should not be studied and understood separately from real life contexts including in culture. It causes mathematics seems like only a set of symbols, formulas, calculation and reasoning techniques do not mean anything, and seem to have no benefit in human life. This situation has an impact on the lack of interest in learning and mastering mathematics.

Kusaeri (2017) said that the existence of mathematics to provide solutions to problems in accordance with the context and age in social life. Like the presence of geometry that developed in ancient Egypt, due to the desire of the farmers in dealing with the problem of measuring agricultural land that is located along the Nile in the form of a rectangle, which then developed the emergence of new knowledge, such as measuring triangles, pentagons, and so on. Indeed, the existence of other simple mathematical activities has been carried out since ancient times or prehistoric times, such as simple visual counting activities of objects around them. One of the proofs has been done by archaeologists in the form of simple calculation systems, measurements and shifts of objects in certain societies in ancient times. The discovery of several bones that have notches at regular intervals, where the aim of the notch is possible to indicate the number of hunted animals killed by the hunter, and how to track their pet.

From the above opinion it can be concluded that every community group is familiar with mathematics even though some of them are not aware of it. This shows that the mathematical culture in certain community groups has taken place massively even though the mathematical concepts, principles and procedures are not obtained from school learning.

Mathematical culture can generate advanced and high-character community activities or vice versa that the progress of a society can generates mathematical activities. This is consistent with the opinion of Gerdes (1994, 1996) that ethno-mathematics describes as the study of ideas and concepts that using visualization of the developing cultural context, so that mathematics can be learn as knowledge that has many functions in life and character of a nation.

Good character or morality is a basic value of religion (Islam). God sent prophets and apostles as deliverers of revelation exemplified by good morals. Prophet Muhammad SAW. in one of the hadiths said "*innamaa buitstu liutammima makaarimal morality*" means "Verily I (Muhammad) was sent to perfect morals." Based on the context of this hadith according to Maksudin (Maksudin, 2013) explains that actually morals in human beings already exist (fitrah), therefore there is the term "perfect", which means that in nature human beings have morals, both to God (Allah), and to others human. Naturally, human know something that is good and bad, something that is right and false, which is useful, and which is bad based on the nature of belief (*qolbu*) and knowledge (reason).

Almawardi in his book "*Adab ad-Dunya wa al-Din*" as quoted by Miskawaih (1999) says "*dharuroh fi ad-din al-aql wa li al-aqli ad-din al Ashli*" which means that religion is necessary for the ratio, and the ratio is the basis of religion. While similar thing also expressed by Albert Einstein "religion without science is blind and science without religion is lame "(Miskawaih, 1999). The opinion inspires us that religion and science absolutely must be synergized because essentially derived from the same source, it's from the God (Allah). The basics acquisition of knowledge (read: science and technology) has been described in the Qur'an in Al-Alaq verses 1-5, which reads (Agama, 1990):

$$اِقْرَأْ بِٱسْمِ رَبِّكَ ٱلَّذِي خَلَقَ ١ خَلَقَ ٱلْإِنسَٰنَ مِنْ عَلَقٍ ٢ اِقْرَأْ وَرَبُّكَ ٱلْأَكْرَمُ ٣ ٱلَّذِي عَلَّمَ بِٱلْقَلَمِ ٤ عَلَّمَ ٱلْإِنسَٰنَ مَا لَمْ يَعْلَمْ ٥$$

This means (i) Read: In the name of your God who created, (ii) Created man from clot, (iii) Read: and your Lord is the most Generous, (iv) He who taught by the pen, (v) Taught man what he never knew,

The above verse teaches knowledge bound by a strong monotheism (*bismirobbikal ladzi kholaq*) and (*warobbukal akrom*). A read command can be interpreted in a broad sense reviewing, analyzing, studying, research, discussion, question, discover, prove, test hypotheses, and so on. That five verses of the Qur'an which fell first on top, giving a message not only to study one science of religion, but a read command is also to examine various other knowledge such as engineering, industry, animal husbandry, agriculture, and even mathematics (*falaqiyah, faraid*, charity, buying and selling, and so on). Furthermore, through read command not only acquire knowledge, but also gain magnificence (*warobbukal Akrom*) which is due to the functioning

of all the human senses, the thought (brain) and the flavor/ mind (heart), which in turn formed by itself personality steady and decorated by a positive character or a noble character (Mulyono, 2003). Therefore, this paper attempts initiated by illustration ideas of ethno-mathematics concept is designed based on the value of religion (Islam) as a breakthrough step to form characters (*akhlakul karimah*) just as our hope.

2 RESEARCH METHOD

This paper is a review of library research that carry out research from literature in the form of books, as well as research reports, journals, and articles which have a relation with the issues to be studied. This article discusses the internalization of Islamic values in ethno-mathematics as an effort to shape the character of the nation through the formation of student character. Thus, the data in this study were obtained from various sources of literature relating to ethno-mathematics, Islamic values, and national character.

3 RESULTS AND ANALYSIS

Some experts give general understanding and specifically to mathematics. One of the experts is Hudojo (1998) said mathematics is abstract ideas which are given symbols that are hierarchically arranged and their reasoning is deductive, so learning mathematics is a high mental activity. Whereas Ramdani (2006) said that mathematics is seen as the science of logic regarding the form, composition, magnitude and other related concepts with a large number which is divided into three fields, namely algebra, analysis and geometry. Thus, based on these two opinions, it means that mathematics can play a role in activity or acting in daily life through thinking and reasoning and skill in communicating.

3.1 Culture and Character

In a study of the history of the development of mathematics from the Mesopotamia, Egypt, and Greece cannot be separated from the high value of local culture. The exist values indicate higher the civilization of the community. Thus, it is not excessive if there is a hypothesis that character can be born from culture and culture that can give birth

to good character. The term culture in Islam is known as *al Saqaafah* or culture, while the character comes from the word al-akhlaq which means good behavior. The figure who is the role model of mankind is God's chosen man, namely Muhammad SAW as a model in life and life in the world to the hereafter. Read: (*wainnaka la ala khuluqin adhim)*. Or read (*laqad kana lakum fi rasulillahi uswatun hasanah*).

Images of human figures expected Indonesia has been reflected in man chosen (perfect man) as the reference every Muslim is the personality of the Prophet Muhammad. He has four characters, that is sincere (*siddiq*), trustworthy (*amanah*), extended (*tabligh*), smart (*fatonah*). Through these four characters, he was able to change the incredible world. According Rukiyati (2013) that the existence of four of these characters are manifestations of human perfection from three sides (i) mind, (ii) the soul, and (iii) the morality or "thinking, feeling and action". Furthermore, he asserted through four (iv) of this noble nature, man is guaranteed to be tough, strong physical, and psychological (healthy brain, healthy heart, and healthy body). Accordingly, the four characters of Mohammad are adopted as the educational goal as well as three notion's Bloom proposal (cognitive, affective, and psychomotor).

Abdurrahman (1995) said that through the example of the Prophet Muhammad would give birth to a human who has the mature moral integrity, stable, mature personally and socially. This is demonstrated through the nature *Sidiq* (sincere) and *Fathonah* (smart) reflects a personal quality as a human being, whereas through the nature of *Tabligh* (communication skills) and *Amanah* (trustworthy) reflects the quality of human figure socially.

Manifestations of these two aspects of maturity (personal and social) that are the core values that are referenced from the human figure perfectly the figure of the Prophet Muhammad bringer of the message of God inspired the character education in Indonesia which derived into 18 indicators of the character education as shown in Table 1.

The term culture is often interpreted as a pattern-intact human behavior and the products of mindset, oral, patterns of action, and artifacts that depends on a person's ability to learn, which aims to convey knowledge to the next generation through a variety of means and tools, language, and patterns of reasoning (Mega, 2016). Thus, the means of cultural values is a matter that cannot be separated from the life of a society, because culture is an integral and complete from various embodiments and behavior in public life.

Culture and characters sometimes appear and develop in specific social communities (Hammond, 2000). Its existence appearance sometimes is natural, which is facilitated by God as ethnicity, race, skin color, the diversity of languages, and more. While the other part can exist because it was created by community groups, such as the arts, customs, language and formal education. Suparlan (1981) defines culture as the whole of human knowledge which is used to interpret, to understand the environment, and to create and promote behavior. Medium culture is the result of activities and the creation of the mind (intellect) of man, such as trust, art and customs.

Based on some of these definitions, it can be concluded that an understanding of the culture is something that can affect the level of knowledge, ideas of the human mind that is abstract. While the culture is the form of objects produced by humans can be behavioral and objects are real, as is the custom, language, equipment life, religion, art, and others, all of which is intended to help humans the continuity of social life.

3.2 Philosophy of Ethno Mathematics

Etymologically, D'Ambrosio (1985, 1999; 2006) initially defines ethno-mathematics as mathematical practices carried out by groups certain cultures, such as certain tribal societies, labor groups, children of the group a certain age, professional grade and so on. In other words, ethno-mathematics develop from local culture that is associated with mathematical thinking, so that it can evolve based needs and problems faced through a cultural context. While the paradigm and direction of development of ethno-mathematics suggested by Rosa and Orey (2000; 2011), states the mathematical concepts embedded in cultural practices, focused on the realization that everyone develop a unique method to understand and change the reality of the cultural community.

The paradigm of cultural diversity can be uniquely interaction between languages with their habits on the environment. Such as planting in agriculture, trade, business activity, weaving, carpentry, etc., which eventually gave birth to the mathematical forms that vary because of cultural activities using mathematical ideas and concepts through quantitative considerations, relational and spatial aspects of their lives. These conditions show that mathematic has indeed united in life and culture of a society.

Studies have shown that there is a link between mathematics and culture, as was done by Clements (Karnilah, 2013). It can be seen from the results of meeting s of the International Community of Mathematics Education which states that issues related to culture will inevitably interact in the learning process of mathematics. It also reflects on all the objects and mathematical concepts. Therefore, the development ethno-mathematics can be directed to activities, ideas, and concepts and mathematical contexts associated with elements of cultural or human creations.

3.3 Mathematical Ideas

The term idea of mathematical often inspired by some of the facts of nature created by the God (Allah) as the form of mountains, caves, sea, sand, trees, flowers, fireworks, the expanse of the earth, rivers, rocks, fish, birds, etc. These facts may be either natural scientific facts and inspired a mathematical idea developed into a certain culture and civilization that are reflected in the activities of life through work activities to meet the needs of their own lives. As well as the caves for shelter from the scorching sun and rain inspire them make a home. Mountains inspire art brick buildings such as the pyramids of Egypt. Piles of rocks inspiring places of worship such as the temple buildings, temples and places of worship of humanity.

Table 1: 18 indicators of characters education.

Foundation	Aspect	Attitude	Characteristic Value	Derivatives Value
Religious	Personal	Sidiq (Sincere) and Fathonah (Smart)	Honestly, curiosity, creativity, reward achievement, happy reading.	Sincere: Believe, faith and piety, self-respect, honest, sportif. Fathonah: Creative, innovative, critical, initiative, productive, disciplined, meticulous, visionary, problem solver, self-contained.
	Social	Tabligh (Able to communicate or care) and Amanah (Trustworthy)	Friends / communicative, democratic, tolerant, national spirit, love of country, love of peace, social care, care for	Tabligh: Care, compassion, concern, sympathy, empathy, helpful, clever grateful, patient, humoris, friendly, neat, responsive.

			the environment, responsibility, hard work, self-contained.	

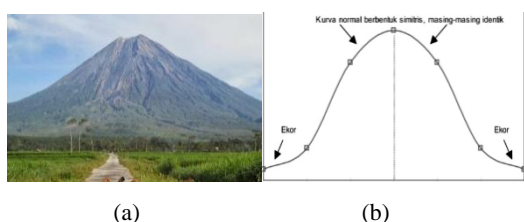(a)   (b)

Figure 1: Interpretation between (a) mountain and (b) curve in mathematics.

The curve (see Figure 1) is a symbol of a person's life, sometimes a person who gets lucky to be interpreted being positioned above the curve and vice versa. It is implied that the curve is as the journey of life. It means that every life is never flat. But there is also the concept of mathematical ideas can inspire a civilization or vice versa, for example geometry such as square, triangular, irregular pentagon, a regular hexagon, circles, cubes, blocks, pyramid and prism (Figure 2), ball even a curve to the number system.

(a)   (b)

Figure 2: Interpretation between (a) pyramid and (b) prism in mathematics.
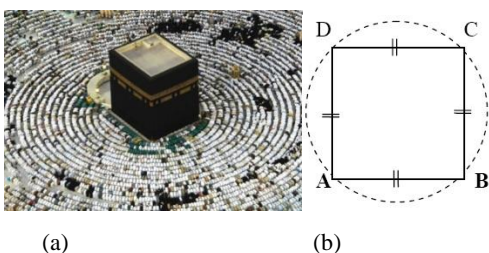

(a)   (b)

Figure 3: Interpretation between (a) Ka'ba and (b) Square and circles in mathematics.

As seen in Figure 3 the activity in the Ka'ba is ritually surrounds the sharia commanded by Islam in performing *tawaf Haj* and *Umrah*. However, *tawaf*

can be understood our focus in reaching the target or goal, it also means the way to enhance the desired destination point.

According to Ascher and Ascher (1997), mathematical ideas covering with numbers, logic, spatial configuration, and the combination or composition in the system and structure. Ascher recognize that there are two aspects in mathematic activities, namely, to understand the relationship between mathematical ideas and habits of life as well as how to modify the learning of mathematics so internalized the ideas in this lesson. Some ideas of mathematics used in arts and culture can be developed in the architecture is the concept tessellation. The tessellation means repetitive drafting a model or form that meets a field, which is in the study of mathematics known as tiling. Some concepts tessellation in mathematics are the form of a regular polygon, congruence, cubes, blocks and circles.

Application of the principles of tessellation encountered in everyday life, such as in engineering tile installation (manufacture of ornaments mosque, temple or house), fabric pattern, batik, design patterns for wallpaper, painting, weaving, carving, and others.

The idea of ethno-mathematics is a mutual influence between mathematics and social and cultural life, economy, architecture. The emergence of mathematical ideas continued to grow along with the development of society, from the ancient primitive societies age, pre-history to the public in modern civilization. Every socio-cultural development of the basic idea is always to be found mathematically describe in a context, it means implicitly mathematics come to give color to build positive character in society.

In fact, it can be found a few examples of naturally occurring teselasi, namely beehive, cobweb, leaves and flowers as shown in Figure. 4.
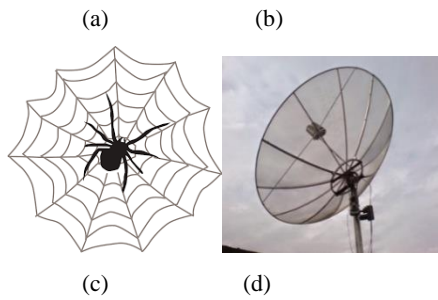
(a)   (b)

(c)   (d)

Figure 4: Interpretation between (a) broccoli and (b) triangles, hexagons, snowflakes in mathematics, (c) spider web and (d) parabola.

Some definitions related to tessellation also expressed by O'Daffer (2008) as follows:

- **Regular Tessellation** "Such a tessellation, made up of congruent regular polygons of one type, all meeting edge to edge and vertex to vertex is called a regular tessellation ".
- **semiregular tessellation** "A tessellation formed by two or more regular polygons with the arrangement of the polygons at each vertex the same ".
- **A Semi Regular Tessellation** "A tessellation is a regular Semi tessellation of regular polygons that has exactly two or three different arrangements about its polygon vertices ".

In other words, for practice tessellation (to tile) there are three regular polygons are triangle, square, and hexagonal irregular. The important thing should be owned by a semi-regular tessellation is formed by irregular polygons and each peak in the polygons should coincide.

3.4 Some Examples of Mathematical Ideas and Culture of Islamic Values

3.4.1 Mosques and its ornaments

Some Muslim artists distribute works of art through nature painting, or geometry painting through the period and a ruler, in order to obtain attractive shapes, until he found a complex pattern (R. Cromwell, 2009). Ornaments used on the walls of the mosque is a form of cultural and intellectual geometry with the calculation of the figures carefully and thoroughly (Lu & Steinhardt, 2007). Its characters are formed is a mental attitude that is innovative, creative, critical, visionary. Moreover, one Islamic geometry art is girih. Girih is decorating with tessellation or tiling technique of Persian. There are at least three elements that are the bending lines, symmetry and repetition.

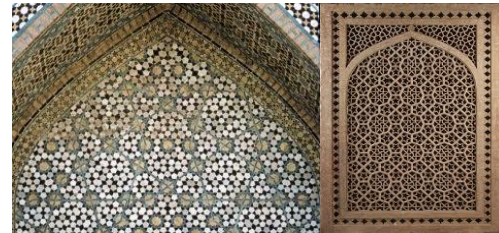Figure 5: The mosque involves the concept of a triangle, rectangle, beams, pyramid and prism.

Figure 6: Ornaments of *mihrob* structured geometry based tiling/semi-regular tessellasion. (Rohayati, Karno, & Chomariyah, 2017)

3.4.2 Webbing

According Hoenigman (Mega, 2016) mentions that the woven art is a form of culture, which is included in the artifacts. Matting firstly is used by human which is to help in their everyday lives. There are at least three types of materials used in webbing, namely bamboo, pandanus, and rattan. Each material has strong characteristics and philosophy. The following pictures Local webbing culture is an expression of human civilization as.
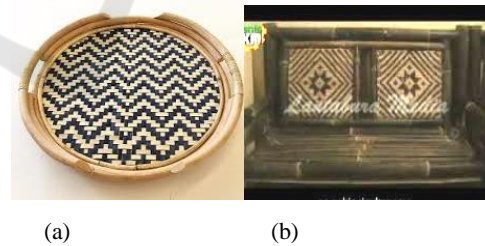
(a)   (b)

Figure 7: (a) A concept of circle woven, (b) Woven square and rectangular form

3.4.3 Weaving

Weaving is a technique in the manufacture of fabrics made with the simple principle a square or a rectangle, by combining the lengthwise and crosswise yarns, usually made of wood fibers, cotton, silk, and more. Weaving art is closely related to knowledge systems, culture, beliefs, the natural environment, and a system of social organization in

the community. Because of the social culture in a diverse society, the art of weaving in each area have differences. Therefore, it has a characteristic and is part of the representation of the people's culture. Mental attitude or character developed is independent, tenacious, resilient, and visionary.

Figure 8: Example of weaving *sajadah*. (Prabawati, 2016)

3.4.4 Indonesian Batik

Batik is a craft that has high artistic value and has become part of the culture of Indonesia (especially Java) for a long time. Batik tradition was originally a hereditary tradition, so occasionally a recognizable motif batik originated from a family or even batik may indicate the status of a person.

Along with the times, batik is now a valuable commodity and prestigious not only for purposes of dress, such as clothes and gloves, but also a decoration and a prayer rug to pray. The moral being offered is persistent, tenacious, independent, visionary, honest, economical, creative, initiative, etc.
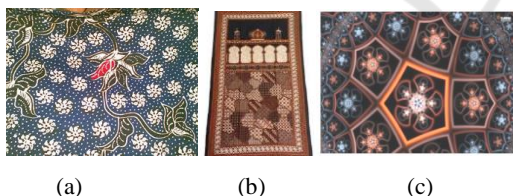

| (a) | (b) | (c) |

Figure 9: Example of (a) The combination of flowers, natural painting, (b) *sajadah*, (c) The combination of the concept of fractal pentagon, circle.

3.4.5 Music and Percussion

Percussion word comes from the Latin term *percussio* means hit and percussus (noun, meaning "punch"). Percussion is musical instrument that produces sound by being hit, beaten, shaken, rubbed, or other actions that make the objects vibrate with a device, a stick (stick), as well as with his bare hands, or complaint with other objects that produce sound. To simplify the classification, a percussion instrument called also with percussion instruments or percussion instruments, such as tambourines,

extension, violin, tambourine, and so on. Some developed moral message is caring, cooperation, dynamic, responsibility, respect, creative, innovative.

| (a) | (b) | (c) |

Figure 10: (a)The concept of rows in the art, (b) A combination of tube concept, (c) The draft tube.

4 CONCLUSIONS

Based on the discussion and analysis above, mathematical ideas inspired, explored, constructed from natural phenomena provided by God the Almighty (Allah SWT) in the form of natural panoramas such as mountains, trees, flowers, beehives and spiders, ravines, and river. In addition, it is also inspired by the activities of human activities in meeting their own needs, such as farming, trading, handicrafts, transportation equipment and sophisticated equipment such as airplanes and computers. So that the mathematical concepts also have many implications in solving problems in everyday life and sustaining the perfection of other sciences, this is in accordance with the term mathematics as Queen of Sciences as well as mathematics is a servant, namely as its servant.

Despite cultural creation continues to change rapidly, mathematics is always relevant in supporting the change in civilization. Mathematics puts forward logical thinking which always goes in line with the common sense of the human mind. That means that mathematics always develops from time to time and the wider its scope is in accordance with the development of common sense of the human mind. For this reason, it is no exaggeration to say that mathematics has contributed and played a significant role in realizing human civilization.

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