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THE IMPACT OF MATHEMATICS IN SHAPING THE UNDERSTANDING OF NATURE AND HUMANITY

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ABSTRACT

With the impact of mathematics in shaping the understanding of nature and humanity, the mathematics educators are concerned on the students' level of proficiency in mathematics education. In this paper, it aims to investigate the understanding of the students on mathematics in nature and mathematics in humanity, and also the impact of this in the society. With result of the assessment of the Philippines on the math-science global assessment conducted by TIMSS 2019, this study analysed the impact of the result of the assessment to the Philippine education. With the analysis of this study, Mathematics educators was found to play the greatest role in facilitating the students' understanding of nature and humanity through math.

Keywords: nature, humanity, assessment, proficiency, society

INTRODUCTION

The impact of Mathematics in shaping our understanding of nature and humanity is still abstract to the eye of everybody. Many people living in this world still do not understand the importance of mathematics. Mathematics in Nature is a science and mathematics unit that most of the people do not acknowledge and try to explore and gain knowledge about mathematical patterns found in nature. Additionally, applying simple arithmetics and doing patterns are not recognized as an existence of math. They don't see how they use mathematics in their lives. And they don't realize that Mathematics is a life. Furthermore, Mathematics is not just a number, shapes or finding x and y, it is a life also.

From waking up to sleeping , working to resting, hearing to speaking, and smiling to crying will always explain to us how mathematics works in our everyday life. Looking at your clock to work and rest is a simple application of math in our life. Working to gain income or to compensate will lead us to do math. Hearing problems from others and speaking to solve the problem proves that math is not just a number. With these simple situations, it shows to us how we use the concept of Mathematics.

Mathematics is the cradle of all creations, without which the world cannot move an inch. Be it a cook or a farmer, a carpenter or a mechanic, a shopkeeper or a doctor, an engineer or a scientist, a musician or a magician, everyone needs mathematics in their day-to-day life. Even insects use mathematics in their everyday life for existence.

Snails make their shells, spiders design their webs, and bees build hexagonal combs. From rainbows, river meanders, and shadows to spider webs, honeycombs, and the markings

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on animal coats, the visible world is full of patterns that can be described mathematically. Examining such readily observable phenomena, the beauty of nature as revealed by mathematics and the beauty of mathematics as revealed in nature will be understandable.

Mathematics in nature is an excellent and undaunting introduction to the ideas and methods of mathematical modelling. It illustrates how mathematics can be used to formulate and solve puzzles observed in nature and to interpret the solutions. In the process, it teaches such topics as the art of estimation and the effects of scale, particularly what happens as things get bigger. With this, it develops an understanding of the symbiosis that exists between basic scientific principles and their mathematical expressions as well as a deeper appreciation for such natural phenomena as cloud formations, halos and glories, tree heights and leaf patterns, butterfly and moth wings, and even puddles and mud cracks. There are countless examples of mathematical patterns in nature's fabric.

In understanding the nature and humanity, mathematics has its big role in it. Visualizing and revealing the truth and existence of mathematics in nature and humanity will lead everybody in understanding, recognizing, and knowing the importance and the purpose of mathematics. To better achieve this purpose, a good curriculum of Mathematics is helpful through effective teaching and learning of the subject. Anyone can be a mathematician if one is given proper guidance and training in the formative period of one's life. And everyone will appreciate and love math if all mathematics educators will develop the skills of every learner by practice the concepts of mathematics in nature and mathematics in humanity.

Mathematics in nature and mathematics in humanity are the two important areas in shaping the understanding of "mathematics is life". These can give truth and existence of mathematics and provide consistent understanding of mathematics in a real picture.

Mathematics in Nature

Mathematics is everywhere. It can be found in the things people make and the works of art they adore. According to Euclid, "The laws of nature are but the mathematical thoughts of God." Even if they don't appreciate it, mathematics may be found in the natural world around us, in the landscapes and species of plants and animals, including humans. It is necessary for our attraction to other people, as well as our mobility.

From the structure of buildings to the discovery of new planets, from trade to fashion and new technologies, mathematics has always served as an important tool in the advancement of science and technology, in fields as diverse as Engineering, Biology, Philosophy and Arts. And it is also present in nature, concealing- and revealing- its charms in various forms, intriguing researchers and inspiring poets. One of the ideas that best embodies mathematics in all its elegance is the concept of symmetry.

The mathematics in nature are geometrical shapes, symmetry, Fibonacci spiral, the Golden Ratio, and fractals. An object is symmetrical when there is "harmony in the proportions" of its parts in relation to the whole: height, width and length are balanced. Strictly associated with harmony and beauty, symmetry is also a decisive concept in theories about nature. Ancient Greece was apparently the first place where this idea had room to develop. The

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roof of the Lotfollah mosque in Isfahan (Iran) is a great example of symmetry endowed with beauty in architecture. Inside the mosque there are several rooms with diverse symmetrical motifs.

The Stanford Dictionary of Philosophy reminds us that in Timaeus, the work of Greek philosopher Plato (429-347 BCE or Before the Common Era), for example, regular geometric forms take center stage in the doctrine of natural elements because of the proportions they contain and the beauty of their forms. The four elements - Fire, Water, Earth and Air - could be represented by regular geometric shapes (with polyhedrons of four, twenty, six and eight equal sides, respectively). The Universe could also be represented by a 12-sided polyhedron - or a symmetrical dodecahedron. When particles with these different forms are combined, they give rise to all the natural elements we know. Although the word or concept of "symmetry" did not exist in Greek vocabulary in the days of Plato, the concept was already developing. The Greek noun "summetria", which literally means "of the same size", was already being used to refer to "proportion".

Some say that the size and proportion of perfect solids described by Plato are related to each other - the sides of particles of fire, water, and air could be combined together because they are proportional. They were described as having a "golden proportion" among themselves or a type of symmetry that marks the growth rate in the development of several species. The leaves of a tree, for example, multiply more or less at this speed after they sprout: 2, 3, 5, 8, 13, 21, 34, 55, ... and so on. The last number is always the sum of the two preceding numbers - and when we divide each number by its predecessor, the result will be very close to 1.6180, or what mathematicians like the Italian Leonardo Fibonacci (1175 - 1250) consider as "the golden proportion". When applied to a succession of proportional squares within a rectangle, this sequence of numbers - always with the golden ratio between them - generates a "golden rectangle". If we draw a line, formed by quarters of a circle, following the progression of the figures formed in it, we have the "golden spiral", as you can see in the drawing on the side.

The Nautilus, a prehistoric mollusk with living 'relatives' in the Pacific Ocean, is possibly the best example of the golden spiral materialization in nature. This form of symmetry may be seen in nature, where it characterizes the growth rhythm of various species - and is also detectable to the naked eye, fitting within the norms that govern the definition of "beauty" in art.

There are several other forms of symmetry in nature. There is a form of bilateral symmetry, like the reflection of an image in a lake that can be divided into two identical parts; and it can also be radial when the image forms around a central point and "radiates" to all sides, such as an open flower or a yellow dandelion. Symmetry also manifests itself in complex forms such as fractals, in which a structure looks similar to the whole on any scale. Also, in the case of sounds and waves of the same frequency, we can say with certainty that sounds and lights are also symmetrical. In the natural world, symmetries are not completely perfect and harbour some visible imperfections. According to IME-USP professor Eduardo Colli,: "our eye looks for symmetries, even if these are not perfect in nature. In fact, the greatest beauty in the symmetries of nature lies in these little imperfections."

One of the main symmetries in nature is bilateral. It can be seen how one side of the body of a plant or animal is a very close copy of the other, as if it were a plane, able to split the image into two sides - or two almost perfectly reflected images. Not infrequently, this

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morphology has a clear function: for example, it would be very difficult for a bird to fly straight if its wings weren't the same size.

An object is spherically symmetrical if it can be cut into two equal halves - regardless of the direction of the cut, as long as it passes through its center. Fruits like oranges and some lemons have a shape that is very close to being spherical. For Plato, the sphere was the most symmetrical and homogeneous form that existed. And therefore the most beautiful and perfect form of all. He said that the Cosmos had a spherical shape - as well as the celestial bodies, like the planet Jupiter we see in the image.

“Fractal", a term coined by the French mathematician Benoît Mandelbrot in the mid-1970s, comes from the Latin word "fractus", or "broken”. This explains the logic of a fractal's geometry: it is a structure with a symmetrical scale. Any part of a fractal, no matter how small, has the same shape as the whole figure. A good example is the cube you see, better known as Menger's Sponge. The figure is named in honor of the Austrian mathematician Karl Menger, who in the last century studied the topology of geometric objects. You can create a Menger Sponge by removing the central part of a cube and repeating the process a few times on an increasingly smaller scale. Probably the best representation of fractal forms in nature is the Roman cauliflower.

Not all the symmetries we know happen in the spatial dimension, in the form of geometric figures or in forms found in nature. Symmetries also exist in the natural world in other ways that we can see, hear, and feel. Light and sound, for example, behave as a wave - and we can say that these are symmetrical when their wavelength is regular. Its symmetry does not occur in space the way a geometrical figure visibly does- its pulsation, light and sound are symmetrical in time. Some stars, for example, have regular variations in brightness, or pulsations. RS Puppis, located near the center of our Milky Way, is one of these: its frequency of pulsation is approximately 40 days.

Symmetries are everywhere all the time. Just look around to see that they surround us. In addition to endowing our daily life with more grace and beauty, they also have many functions of which we are unaware. Nature hides numbers, equations, and proportions that can be unraveled by anyone who is curious enough. As the celebrated physicist Richard Feynman once said, "Knowledge of science only enriches the excitement, mystery, and admiration" for nature. It does not take away its beauty.

Mathematics is everywhere in this universe. Many seldom note it. We enjoy nature and are not interested in going deep about what mathematical idea is in it. Mathematics expresses itself everywhere, in almost every facet of life – in nature all around us.

Mathematics in Humanity

Any great form of human activity-mathematics, science, art, philosophy, literature, religion, and so on – reveals, in some measure, what is most characteristic and most significant in the distinctive nature of Man; and any form at the same time serves as a more or less potent agency for guiding the conduct of human life. The measure which it performs the twofold function of revelation and guidance is the measure of what called humanity (Keyser, C., 1933). As a discipline of the humanities, the field of mathematics can be considered a creative cultural

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achievement since it is only accountable to human thinking (Mühlhölzer, F., Stuhler, U., & Tschinkel, Y., 2008).

In all the entire history of education, mathematics has held its leading position among all other school subjects because it has been considered as an indispensable tool in the formation of the educated man. According to Griffiths (1974), the educated man, is the knowledgeable man, trained to approach the affairs of his daily life with sense of detachment and objectivity and to reason about them soberly and correctly. Mathematics is the only subject that can be used in all cultures of the world to produce the educated man. Mathematics is the means of sharpening the individuals mind, shaping his reasoning ability and developing his personality. It has helped to contribute immensely to the general and basic education of the people of the world. The importance of mathematics is not restricted to the development of the individual alone. Mathematics has contributed to the development of society; it is the central intellectual discipline of any technological society. No society is static, as each society develops, its quantitative aspects assume ever greater and increasing influence and dominance over its quantitative features and a good account of the quantitative development can only be kept by means of mathematics understanding of the situation. It is therefore not surprising that mathematics has pervaded the entire organized activities of human society. It is the language used in all cultures of the world and in all works of life. It's used in musical composition and parlour games like the common Ludo games, the Scrable and Yoruba Chess (Ayo).

The importance accorded mathematics in the school curriculum from the primary school to the secondary school level reflects accurately the vital role played by the subject in contemporary society. At the most basic level, the knowledge of mathematics is essential in the conduct of everyday living and in commerce, engineering and the natural and social sciences, advanced mathematical concepts and techniques are indispensable tools.

a. Mathematics and human daily activities

From the ancient Egyptian onwards, mathematics has had two aspects. One of which is the aesthetic, which is completely devoid of practical applications. This is the aspect which deals with the love for mathematics itself. Studies and researches are carried on in it for the sake of mathematics alone, motivated by a kind of scientific inquisitiveness. Man, beginning from the Greeks days has always enjoyed the contemplation of numbers and geometrical figures, the discipline of controlled imaginative thought and the thrill of discovering new mathematical relationships. It was the Greeks who began the science of mathematical reasoning.

Prior to their days, mathematics does transcend the boundary of practical usage. The early mathematics was purely empirical in nature, arrived at by trial and error and no proofs were given to explain any results obtained. There was no interest in the mental struggles needed to undertake to reach a result. People were merely contended if the result worked. If the result worked, that was a proof enough of the mathematical undertaking. The Greeks were not contended to show that the results worked. They wanted to explain the reasons and this they tried to do by the shortest logical experiment they could device. Thus the writing of proofs became an art in which it was a matter of pride to be economical as much as possible with the steps in reasoning and yet leave no loopholes. These led to the formulation of theorems. The Greeks accumulated a store of proved theorems, all of which could be arranged in an ever-widening inverted pyramid of knowledge. The point at the bottom of the pyramid could be

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firmly entrenched in everyday experience through a few self-evident axioms, such as "The shortest distance between two points is a straight line".

Mathematics today uses some of the assumptions and proofs of the Greek days, although there could be few changes here and there, but the basic Greek system of abstraction and proof remain intact. People have continued to derive joy and satisfaction from this aesthetic aspect of mathematics. Many studies were prompted by this desire of personal satisfaction and many more will be kindled in the heart of people by the same reason. From the foregoing, mathematics has offered people personal joy and satisfaction as music does to the mind, providing the higher emotions and mental pleasures most needed by human being. The other aspect is the practical aspect of mathematics which stems from everyday life. Its very beginning and development have been motivated and guided by the application to these problems and everyday life situation. In this regard, mathematics has become a tool for other sciences and a provision of solutions to problems of everyday life. From its very beginning mathematical development has its roots in practical requirement. Man's first engagement in mathematics was prompted by the practical needs to count things around him, especially his possessions, such as flocks and farm products. The early men probably formed numbers with their fingers, matching their fingers with sets of objects. This support the view of some researchers like Fackuade (1981) who explained that the base ten numeration system, that is, the decimal system most probably came into existence because man has ten fingers that is quite certain, it's on the basis that the first ten numbers are called digits, as they can be represented on ten fingers of the hand. Writing as a practical application of mathematics by the early man, Alfred (1964) said that the early man not only counted his fingers but could transfer information or objects represented by a finger, by a single cut or stroke on walls of his home. He could therefore have many marks, each one representing an object. In this way, it would be possible for him to see at a glance the total number represented by a collection of these strokes, of course by counting them one by one. Records have it that many ancient caves have such markings which are revelation of man's earliest attempt to represent spoken numbers by written symbols.

As the quantitative aspect of the society became more complicated, man engaged in fairly elaborate calculations involving subtraction, multiplication and division. This then marked the humble beginning of arithmetic and methods of computing. The devices that were used for calculation were very simple. They include pebbles, sticks and the usual marking or drawings on the wall. These devices grew more advanced as the situation demanded and by the time of the ancient Greeks man had devised mechanical calculators which were invented as a result of application of mathematics in the UNESCO Publication on New trends in mathematics teaching (1973) the account on the importance of mathematics.

The arithmetical literacy, which is skill and understanding of the fundamental operations with whole and rational numbers in decimal notation, on the part of millions of inhabitants of our planet shows either a lack of school or failure in instruction at the elementary level. Because of the importance of this knowledge in every facet of everyday life, it goes without question that the acquisition of skill and understanding of arithmetical computation and its application to the solution of everyday problems is still the primary objective of elementary school mathematics.

Arithmetic literacy is a necessary tool for the daily living of the people of any society. In many situations of life, an individual is faced with the task of taking some decisions. Many of these decisions can be taken more rationally if approached quantitatively. At more personal

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level, a person going to the market would need to decide on whether he has enough money to get what he needs and hence plan within the limit of his purse. At community levels, firms and other establishments, some level of mathematical competence is required for executing decisions, making policies and taking decisions. Heads of departments in all forms of establishments, from the community through to the highest governmental levels take decisions from time to time as whether to spend money either in one way or the other. Such decisions would be better taken if such Heads have mathematical understanding of the financial position of the establishments and be able to make some predictions as to what gains could be made through such spending.

The need to have a mathematical understanding of financial situation explain the root of some daily problems arising from financial mismanagement by husbands and house-wives in time of economic depression which could be traced to their lack of mathematical reasoning ability required to handle the family finances under their control. The importance of mathematics to the individual in his daily undertakings is so enormous that the knowledge of mathematics is an indispensable tool for a successful and balance human existence on this planet.

b. Mathematics and personality development

Personality, according to the principles of psychology evolves through a process of integration of the whole man. Psychologist describes the integrated beings as that person who is able to take a wider as opposed to personal or sectional view in most questions. Such a person will be constructive rather than just critical in a difficult situation. These qualities make the integrated person an individual who is always trying to unite things rather than separate them. For sure, he will seek connections rather than differences and perhaps most importantly, he will be able to make a good adjustment to his environment by establishing a fundamental identity of interest between himself and his fellow men.

Mathematics provides the forum in which this process of integration could be held, developed and internalized. The faith in mathematics to produce integrative effects on human personality dated as far back as the days of Pythagora. Mathematics was to people of that age, a discipline of mind “disciplina mentis” and so it was clear to all who believed in education.

In the ancient Egyptian Society, mathematics was taught in order to achieve the desirable state of being a priest. The priests were highly honoured and considered as men of high esteem and personality who acquired their exceptional status through the discipline of mathematics. They were men of mathematics.

With these two areas of “mathematics is life”, it shapes the person’s perception in mathematics. It gives a wide understanding about math in this world. It shows discrete and concrete applications. It develops a critical thinking and logical reasoning of man’s mind. And it makes every individual to be a problem solver and mathematician. So, it is highly encouraged everyone to acknowledge the presence of mathematics in our life.

Discussion of Results and Findings

With this study, the impact of mathematics on creating our view of nature and people is still intangible. Many people in this world still haven't grasped the significance of

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mathematics. Mathematics in Nature is a scientific that most people are unaware of, despite the fact that many individuals are interested in exploring and learning about mathematical patterns found in nature. Furthermore, simple arithmetic and pattern recognition are not considered to be part of math. They are oblivious to how mathematics is used in their daily lives. They also fail to recognize that mathematics is a way of life.

Unrecognizing mathematics is not interested in mathematics. With its simplicity in nature and humanity, still, the understanding is unachieved. This is the reason why many are failing and do not understand the importance of math. With this kind of attitude, it leads them to misunderstand the essence of mathematics.

Recently, the Department of Education (DepEd) in the Philippines was alarmed to the performance of the Filipino learner in the math and science assessment. “PH lowest among 58 countries in math, science – global assessment”, reported by Rappler last December 09, 2020. The Trends in International Mathematics and Science Study (TIMSS) 2019 showed the Philippines scored 'significantly lower' than any other country that participated in grade 4 math and science assessments. It proves that the Mathematics Education in the Philippines was not fully recognized.

The study found out that only one percent (1%) of Filipino students reached the high benchmark in mathematics, which means "students apply conceptual understanding to solve problems.” "Students can solve simple measurement problems. They demonstrate understanding of geometric properties of shapes and angles. Students can interpret and use data in tables and a variety of graphs to solve problems," the research institution said in its report. About six percent (6%) of Filipino students reached the intermediate benchmark, where they can "apply basic mathematical knowledge in simple situations." Around nineteen percent (19%) of them finished in the low benchmark, which shows they possess "some basic mathematical knowledge."

With this performance of the Filipino students in Mathematics Education, it truly shows that the learners had low proficiency in Mathematics. This means that the interest and eagerness to learn math is absent. Even in simple application of conceptual understanding to solve problems and demonstrating the understanding of geometric properties of shapes and angles, about 99 % of the Filipino learners did not achieve that competency. With this result, their knowledge in Geometry is poor and the learners are not competent. And it alarmed the Philippines in the proficiency of the learners in Mathematics Education.

Now, Because of the congested curriculum which resulted to low proficiency in math and science, Philippines has implemented new curriculum (K-12) in the basic education which to develop lifelong learning and employment. Different sectors now of the government are working for the new mode of teaching and learning to strengthen the learners’ education. During the start of the pandemic, the DepEd recommended to use Most Essential Learning Competencies (MELCs) to better achieve the goal of the Philippine Education and globalization.

To support the vision for school mathematics in the Philippine Basic Education curriculum, it is also important to provide assessment strategies and guidelines. Whereas the prevailing belief was that successful mathematics learning is evidenced by computational proficiency (National Research Council, 2001), this document emphasizes clarity in what a mathematically competent student is expected to do at the terminal year of each cluster. In this

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light, the assessment tools given not only provide evidence about a student's computational facility but also about each student's ability to apply mathematical concepts and reasoning to real-life situations, see and generalize patterns in diverse situations, read and communicate mathematics. This is done by examples which require students to go beyond answering problems with closed and clear-cut answers. The questions are particularly chosen to encourage students to investigate concepts, make conjectures and connections, show reasoning and communicate ideas.

Discussion

The body of knowledge and practice known as mathematics is derived from the contributions of thinkers throughout the ages and across the globe. It gives us a way to understand patterns, to quantify relationships, and to predict the future. Math helps us understand the world and we use the world to understand math.

The world is interconnected. Everyday math shows these connections and possibilities. The earlier young learners can put these skills to practice, the more likely we will remain an innovation society and economy.

Mathematics is a universal language that transcends civilizations and allows people to express themselves in a clean and accurate manner. It is a language that is utilized in games, markets, institutions, and any other setting where people communicate. Mathematics is a tool for shaping and polishing man's thinking, as well as a discipline worth learning for its own sake, capable of providing pleasure and happiness to those who can study it. Our daily tasks require mathematics for accurate comprehension, quantification, and record keeping.

As a result, in order to develop a society of knowledgeable men and women who are able to approach the affairs of daily life objectively and reason correctly, a strong emphasis on the teaching and learning of mathematics from the primary school level of the nation's educational system must be placed. Only then will we be able to establish a society where people are disciplined in their assessment of themselves in respect to life in society.

Thus, we can see how mathematics has evolved into a language - a means of communication and description that is increasingly being utilized by individuals from all walks of life; as a course of study for its own sake, capable of providing pleasure and happiness to those who are able to study it. Because no culture is static and the demand for higher heights in science and technology will continue to grow, mathematics is required for the development, maintenance, understanding, quantification, and record keeping of our society. The demand for mathematics will continue to rise. In view of the universal importance of mathematics to man on earth, it becomes compulsory that those charged with education (Mathematics Educators) should find ways of involving more of the younger generation of our days in the study of mathematics.

The present age is one of skill-development and innovations. As a mathematics educator, the more mathematical we are in our approach, the more successful we will be. Mathematics offers rationality to our thoughts. It is a tool in our hands to make our life simplier and easier.

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Let's make our learners realize and appreciate the beauty of the subject and embrace it with all our heart. It is a talent which should be compulsorily honed by all in every walk of life.

With that, if students are given the right content and context for a globally infused math curriculum, they'll be able to make global connections using math, and create a math model that reflects the complexity and interrelatedness of global situations and events. They'll be able to apply math strategies to solve problems and develop and explain the use of a given math concept in the global sense. And they'll be able to use the right math tools in the right situations, explain why a math model they chose is relevant. More importantly, students will be able to use data to draw defensible conclusions, and use mathematical knowledge and skills to make real-life impact.

For students to function in a global context, math content needs to help them get to global competence, which is understanding different perspectives and world conditions, recognizing that issues are interconnected across the globe, as well as communicating and acting in appropriate ways. In math, this means reconsidering the typical content in atypical ways, and showing students how the world consists of situations, events and phenomena that can be sorted out using the right math tools.

At the heart of any discussion on a global curriculum through math, it's important to consider how the math helps students make sense of the world, what in a student's experience enables them to use the math to make contributions to the global community, and what math content students need to solve complex problems in a complex world. Then, the challenge for educators is "how can they find genuine, relevant and significant examples of global or cultural contexts that enhance, deepen and illustrate an understanding of the math?"

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