MARIANO MARCOS STATE UNIVERSITY
College of Teacher Education

Center of Excellence in Teacher Education

History and Philosophy of Science

JULIUS C. PUMARAS
Assistant Professor III
jcpumaras@mmsu.edu.ph

The Nature of Mathematics

Mathematics relies on both logic and creativity

Objective:

- discussed the historical background of Mathematics
- internalized the nature of Mathematics
- applied practical teaching practices in teaching Mathematics

Mathematics is the science of patterns and relationships.

- explores the possible relationships among abstractions without concern for whether those abstractions have counterparts in the real world

- The abstractions can be anything from strings of numbers to geometric figures to sets of equations

- Mathematicians are interested only in finding a pattern or proving that there is none, but not in what use such knowledge might have

Mathematics is the science of patterns and relationships.

- A central line of investigation in theoretical mathematics is identifying in each field of study a small set of basic ideas and rules from which all other interesting ideas and rules in that field can be logically deduced.

- Mathematicians, like other scientists, are particularly pleased when previously unrelated parts of mathematics are found to be derivable from one another, or from some more general theory.

Mathematics is the science of patterns and relationships.

- Part of the sense of beauty that many people have perceived in mathematics lies not in finding the greatest elaborateness or complexity but on the contrary, in finding the greatest economy and simplicity of representation and proof.

- As mathematics has progressed, more and more relationships have been found between parts of it that have been developed separately—for example, between the symbolic representations of algebra and the spatial representations of geometry.

Mathematics is also an applied science.

- Many mathematicians focus their attention on solving problems that originate in the world of experience.

- They too search for patterns and relationships, and in the process they use techniques that are similar to those used in doing purely theoretical mathematics.

Mathematics is also an applied science.

- Or they might tackle the area/volume problem as a step in producing a model for the study of crystal behavior.

- The difference is largely one of intent. In contrast to theoretical mathematicians, applied mathematicians, in the examples given above, might study the interval pattern of prime numbers to develop a new system for coding numerical information, rather than as an abstract problem.

MATHEMATICS, SCIENCE, AND TECHNOLOGY

- The relationship between mathematics and the other fields of basic and applied science is especially strong - business, industry, music, politics, sports, medicine, agriculture, engineering, and the social and natural sciences.

- Science provides mathematics with interesting problems to investigate, and mathematics provides science with powerful tools to use in analyzing data.

MATHEMATICS, SCIENCE, AND TECHNOLOGY

- Abstract patterns that have been studied for their own sake by mathematicians have turned out much later to be very useful in science.

- Science and math are both trying to discover general patterns and relationships, and in this sense they are part of the same endeavor.

MATHEMATICS, SCIENCE, AND TECHNOLOGY

- Mathematics is the chief language of science. The symbolic language of mathematics has turned out to be extremely valuable for expressing scientific ideas unambiguously.

Mathematics and science have many features in common.

- a belief in understandable order;
- an interplay of imagination and rigorous logic;
- ideals of honesty and openness;
- the critical importance of peer criticism.

Mathematics and science have many features in common.

- the value placed on being the first to make a key discovery;

- being international in scope; and

- with the development of powerful electronic computers, being able to use technology to open up new fields of investigation.

Mathematics and technology have also developed a fruitful relationship with each other. The mathematics of connections and logical chains, for example, has contributed greatly to the design of computer hardware and programming techniques.

MATHEMATICAL INQUIRY

Using math to express ideas or to solve problems involves three phases:

1. representing some aspects of things abstractly,
2. manipulating the abstractions by rules of logic to find new relationships between them, and
3. seeing whether the new relationships say something useful about the original things.

Abstraction and Symbolic Representation

- Mathematical thinking often begins with the process of abstraction—that is, noticing a similarity between two or more objects or events.

- Aspects that they have in common, whether concrete or hypothetical, can be represented by symbols such as numbers, letters, other marks, diagrams, geometrical constructions, or even words.

Manipulating Mathematical Statements

- Symbols can be combined and recombined in various ways according to precisely defined rules.
- Sometimes that is done with a fixed goal in mind; at other times it is done in the context of experiment or play to see what happens.
- Sometimes an appropriate manipulation can be identified easily from the intuitive meaning of the constituent words and symbols; at other times a useful series of manipulations has to be worked out by trial and error.

Manipulating Mathematical Statements

- The symbol A for the area of any square may be used with the symbol s for the length of the square's side to form the proposition A = s2. This equation specifies how the area is related to the side—and also implies that it depends on nothing else.
- The rules of ordinary algebra can then be used to discover that if the length of the sides of a square is doubled, the square's area becomes four times as great.

Manipulating Mathematical Statements

- More generally, this knowledge makes it possible to find out what happens to the area of a square no matter how the length of its sides is changed, and conversely, how any change in the area affects the sides.

Application

- More generally, this knowledge makes it possible to find out what happens to the area of a square no matter how the length of its sides is changed, and conversely, how any change in the area affects the sides.

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Laoag City, Ilocos Norte, Philippines
(63) 77-600-2014
cte@mmsu.edu.ph

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