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Philosophical Goals of Science and Mathematics Education: Reflective Review

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ABSTRACT

This paper is a collaborative effort among educators and researchers who reviewed issues on what is science and mathematics education for? what is mathematics striving for? Wherein, reviewed the contents of preferred articles: Aims of Mathematics Education (Rameley,2007); The Philosophy and Goals of Science Education (Hodson,1985) using a purposive approach thru design thinking methods, synthesized related literature to formulating views that generalized a concept of understanding based on the author's logical understanding. And using grounded theory findings revealed that in this present era, science was distinctly used to calculate societal workloads, and in school, people were used to calculating mathematical problems. It was determined Both in and outside the school premises that science and mathematics were infused, and people shifted from teaching competencies that computers can do rather than focusing onward to competencies that complement computer capabilities.

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Introduction

The mindset of Dr. Monaliza T. Sasing, Faculty In-charged of EDSC 305 Seminar: Issues and Trends in Science and Technology, one of the Professors of the University of the Philippines Open University (UPOU) with her good intentions, encouraged everyone to secure logical concepts pertaining to science and mathematics education by conducting research that suffices to answers question on "What science and mathematics education for? And "What does Mathematics strive for?" though, questions like this can be directly answered by anybody either by thoughts or by opinions, one's perspective and beliefs on sciences and mathematics education. However, the challenge took the author to generate an article that would redound to answers to those hypothetical-logical concepts, and to contribute comprehensive results that suffice answers on what science and mathematics education is for? and what does Mathematics strive for?

Methods and Materials

In lieu of its objectives, supporting evidence justified any answers thereby using the purposive approach and focus group discussion in content analysis and employing grounded theory to evaluate the documents as suggested, expedient to explore the validity of this study, the authors took advantage using the potential of the technology in synthesizing more literature that exhibits related issues partake to distinguish concerning to science and mathematics education, and due to pandemic issues (Covid-19) the authors preferred to do a collaborative effort in gathering data using design thinking skills from among their peer, co-educator-relatives within the province of Surigao del Norte, Philippines that can reach out either by online or by phone. Then, secluded relevant data, and analyzed logically redound to satisfy those basic questions as expounded in the next subsections [1-8].

Results and Discussion

With grounded theory raised hypothetical-logical concepts have been persuaded below:

What is Science and Mathematics Education for?

Let us define first these two basic words "science" and "mathematics". **Science based** on Encarta Dictionary is particularly defined as a study of the physical world that directly explains the study of the physical and natural world and phenomena, usually by using systematic observation and experiment. And **Mathematics** is the study of relationships using numbers, shapes, and quantities. It uses signs, symbols, and proofs and includes arithmetic, algebra, calculus, geometry, and trigonometry.

The Philosophy of Science Education (Chapter 3: Goals and History of Science Education, n.d.) [9].

In the 1930s when science educators insisted that science education should be an integral part of general education in a democratic society, Science education should prepare individuals to utilize science to improve their lives and cope with an increasingly technological world. Based on previous studies the main reasons for science teaching are: First, to provide background for citizenship; Second, to provide background for those entering occupations or careers oriented toward science and technology; and Third, to contribute to the preparation of scholars, Then, [10] proposed the inclusion of the following objectives to the science curriculum:

- The development of a productive workforce that will maintain economic prosperity and security (a nationalistic, economic goal);
- The development of a literate citizenry that is knowledgeable about scientific and technological issues and able to make informed decisions in their public and private lives (scientific literacy goal);
- The widespread adoption of the intellectual style of scientists, which is equated with better thinking ability (an academic or discipline-centered goal);
- The development of the ability to apply social, ethical, and political perspectives to interpretations of scientific information (an application goal).

However, the tide has turned in favor of developing science curriculum programs whose goals are solidly based on the interaction of science and its citizens. Gone are the days (at least for now) when science is viewed as the pristine discipline, with its underlying assumptions and tacit way of knowing, to be learned by every schoolchild, as if he or she were a little scientist.

Issues and Trends in Science and Mathematics Education

Some issues raised by Ramaley are that universally in this real-world computers were used to solve problems, both in and outside of the school premises probably industry mathematical problems were solved by software, and in school, the professor formulates problems for students to solve [11].

This scenario presumed by some researchers that in the near future mathematics education would have to shift away from teaching competencies that compete with what computers can do and start focusing on competencies that complement computer capabilities, and looking forward to the role of mathematics in the digital society is both pervasive and invisible.

The role of mathematics grows together with the role of technology, as mathematics is at the core of what computers do. At the same time, the omnipresent mathematics is mainly hidden in all sorts of apparatus, which function as black boxes for its users. This leads to the apparent paradox that, in spite of the central role of mathematics in our society, we do not see mathematics and only a few people seem to do mathematics. We might add that, today, basically all mathematical operations that are taught in primary, secondary, and tertiary education can be performed by computers and are performed by computers in the world outside school. This reveals a tension between what is going on in society and what is going on in schools. Thus, in the real world technology-computers were used in calculating, and in education, people are used for calculating these conclusive insights precede to justify that in this 21st Century Science and Technology is not an issue anymore but rather a reality that people in this present era should be adoptive about the trends of nature, that without science and technology, our country will be left behind as to progress and development as if this issue is a replica stratum which means what we desire is reflected what we perform either in school or in social intervention.

What should Mathematics Education Strive for?

Apparently, based on the theory of Ramaley as he explained that in this real-world wherein both science and mathematics are applicable in translating practical problems into mathematical problems; solving the mathematical problem; interpreting and evaluating the outcomes through technology application [11]. Yet, certain investigations took place that due to digitalization and globalization, many organizations and educators have argued that students must develop 21st-century skills to be an effective post-educator, that they come to similar lists of skills: critical thinking and problem-solving, collaboration across networks, agility, and adaptability, initiative, and entrepreneurialism, effective communication, accessing and analyzing information, and curiosity and imagination, and that STEM has appeared generally as preeminently fit for fostering. In this 21st century, students should prepare for their future in the digital society, mathematics curriculum goals should be inclined to the teachers and textbooks' authors, the fundamental change in curricula, tests, and instructional practices, could be possible with the broad support of policymakers, and the society as a whole. These successful educational changes aim at the importance of public awareness of the need to prepare students for their future in the digital society. In reality, this three perspective should be considered: First, as mathematics at the workplace differs significantly from school mathematics, we will try to chart the characteristics of mathematics at the workplace, in order to get an image of what mathematical activity the students have to be prepared for; Second, to anticipate the demands of the 21st century, we will take our starting point in the prospect that everybody will be working in a computerized environment. Here, we will take a more analytical approach when trying to identify the mathematical competencies that complement the work of computers; Third, we will speculate on how the increasing use of information technology will affect the mathematical topics that gain significance under the influence of the use of information technology in order to identify what mathematical content will have to be pursued. Those explanations were based on his scientific and scholarly studies yet some researchers evaluated that there is no significance in mathematics in the workplace compared to school.

Issues in Mathematics Education

Accordingly, Gravemeijer, Stephan, Julie, Lin & Ohtani raised the question "What mathematics education may prepare students for the society of the future?" wherein, the variety of workforce includes: mathematics of carpenters, pool builders, masons, builders, nurses, and structural engineers findings that the mathematics taught in school settings is typically not the mathematics people used to be successful in their workplace [12-21]. In fact, one study showed that while a majority of nurses are unsuccessful on school-based proportion tests, they are 100% accurate when administering medicines with incorrect ratios using personally created strategies [22-23].

In scenario teachers formulated problems and their students find their solutions in order to pass the examination, whereas in the workplace problems are often created by the worker, and this was emphasized that engineers suggested changes in teaching methods such that instruction should not only be about solving equations correctly, but it should also focus on how to represent the key features of a real phenomenon this discourse in the workplace differs radically from school settings as well [24].

The meanings of certain mathematical symbols and words are negotiated in the activity setting of which workers or students are a part [25]. This means that the mathematical language and symbols that workers use may not carry the formal significance of those in school settings (recall the idiosyncratic use of the Cartesian plane by lab chemists). Change over Time. Technological advances rapidly change the role of skilled and unskilled workers in the workplace. Planning functions in an organization were once the purview of management-level workers; however, technology has taken over the work of any unskilled laborers requiring a different set of skills to be successful in the workplace [20].

The evolution of technological devices has fundamentally lessened the need to compute in the workplace and often workers do not recognize the necessity and presence of mathematics in their jobs. Technology has also relegated mathematics to a black box, making mathematics invisible to the worker [26].

The International Community of Teachers of Mathematical Modelling and Applications (ICTMA) tends to focus more on the role of modeling in the service of learning and doing certain mathematical concepts. However, the motivation for creating and interpreting models in the workplace is to mathematize a realistic situation for the purpose of answering a practical question, not to learn a mathematical idea, this approach aims at fostering students' Mathematics Education of the Future, denoted as Model Eliciting Activities (MEAs) but based on reality modeling involves using the mathematical concepts and procedures, which modelers have to connect with applications, which often is a problem with school mathematics hence, adopting modeling and applying as goals, therefore, has implications for the character of the mathematics being taught, as it was elaborated on this issue further when discussing the category "understanding." there is, however, one more point we want to raise: not all workers will be active modelers [27-28].

In relation to this, Thompson, Philipp & Boyd spoke of a calculation orientation, which they contrast with a conceptual orientation [29]. Teachers with more orientation on calculating tend to disregard both the context and the manner in which the calculations arise from understanding the context. They primarily speak in terms of numbers and operations, focus on identifying and performing procedures, and aim at producing numerical solutions. The Teachers with a conceptual orientation, in contrast, strive for conceptual coherence and focus on supporting students in coming to grips with the role and meaning of the numerical values in the situation and how this translates in numerical operations. An implication of this work is that a conceptual orientation to mathematics is more conducive to understanding mathematical modeling. Understanding. Workplaces have not only become increasingly highly automated, but companies are also trying to respond flexibly to customer needs. The consequence thereof is that employees at many levels have to understand what is going on in order to be able to communicate with both colleagues and customers.

Based on the context of the existing text from the following references: The Aims of Mathematics Education [11]; and The Philosophy and Goals of Science [30], are:

- The 21st Century has brought a variety of computer tools that are available in the form of handheld calculators, spreadsheets, computer algebra systems, graphing tools, and so forth.

This means that students will have to learn to work with these types of computer tools. Often, this will not only concern technical instructions—as in the case of spreadsheets—but may also involve complex processes. As an example of such a process, we may refer to what researchers of "computer algebra systems" (CAS) call "instrumentation" [31].

- The goal of mathematics education, however, is also to prepare students for further education to which we may add the importance of understanding and appreciating mathematics as a goal in and of itself.

Thus, a proper balance will have to be sought. This does not necessarily entail an opposition; formal abstract mathematics may also support practical applications. We may illustrate this with the number theory. Number theory concerns number systems, properties and relations of numbers, special numbers (triangular numbers, square numbers, perfect numbers, and prime numbers), divisibility, etc. These are issues that are relevant in the digital society in connection to modern phenomena like coding, hacking, etc. Further, it can be taught on a very elementary level; number theory is very suitable to let children explore, experiment, and ask themselves questions relevant to the history of mathematics and to our human heritage, which in itself can be seen as a goal of mathematics education.

It was also emphasized that Mathematics educators and policymakers should treat mathematics calculations and abstract mathematics equally essential, taking into account that specific attention will have to be given to mathematics-specific forms of argumentation and communication, and preparing students for mathematics in the workplace is one of the goals of mathematics education.

What does Mathematics Strive for?

First, taught as to be useful, and balancing canonical and non-canonical forms of mathematics & 21st Century digitalization of society requires a focus on mathematical competencies that complement the work of computers;

Second, prepare students to have self-reliance and self-confidence when dealing with mathematics in everyday life and active citizenship;

Third, emphasize the importance of one of the key 21st-century skills: critical thinking;

Fourth, attention to mathematics that has practical relevance outside school should not marginalize the importance of preparation for further education, or the value of mathematics as part of our cultural inheritance; and

Fifth, update mathematics education in terms of both content and technique. Our discussion is intended to spark a more global conversation and, perhaps a more organized action, on mathematics education for the future.

Conclusion

Based on the interaction of science and its citizens even during the 19th century up to this present era science and mathematics education strive for the development of a productive workforce that will maintain economic prosperity and security; the development of a literate citizenry that is knowledgeable about scientific and technological issues and able to make informed decisions in their public and private lives (scientific literacy goal); widespread adoption of the intellectual style of scientists, which is equated with better thinking ability (an academic or discipline-centered goal); development of the ability to apply social, ethical, and political perspectives to interpretations of scientific information. Thus, profoundly reflective that the 21st Century digitalization of society was the outcome of the little scientist with pristine discipline during their times.

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Ethical Statement

Not applicable

Consent Statement

This article does not involve human intervention and animal interference, rather this is beyond the authors" perspective and personal assessment on their experiences, wherein they wish to brought out for global information.

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