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MATHEMATICS AND MATHEMATICS EDUCATION FOR THE ENTIRE HUMAN RACE: A CHALLENGE FOR THE 21ST CENTURY

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ABSTRACT

This paper shows that Mathematics education is purely a human activity. Conceptualizing mathematics education as the activity of few isolated specialists to the detriment of the realm of human cultures makes it not attractive to many students and the human race in general. If mathematics is to become a common property of humanity,mathematicians themselves need to learn to transcend their own tribal inclinations to not only entertain the possibility that the observations and stories of people that are not mathematicians are relevant, but to begin actively valuing them to genuinely open the mathematics educators' community to all people that want to study mathematics. Hence, our mathematics education curriculum should be redesigned to bear on broad concerns of all rather than to train mathematicians, but to engage all students with Mathematics, and develop supplementary specialized curricular for those aspiring for professional careers in Mathematics related fields.

Keywords: Human activity, common property, Mathematics educators' community, observations, curricular.

INTRODUCTION

Mathematics Education is the process of facilitating Mathematics learning, or the acquisition of Mathematical knowledge, skills, values, beliefs, and habits. Educational methods include storytelling, discussion, teaching, training, and directed research. Mathematics education frequently takes place under the guidance of mathematics teachers, but learners may also educate themselves. Mathematics is a physical Science involving abstract representational system used in the study of numbers, shapes, structure, change and the relationships between these concepts. On the other hand, science educators defined Science in many different ways depending on the purpose and professional experiences. But for the purpose of this presentation, we prefer the simple and operational definition of Science by Fisher, (1975) and modified by Olarinoye, (2009) as "Science is the body of knowledge obtained by methods based upon observations".

Indeed, it is the realm of nature of matter both living and non-living that can be observed. Hence, Science here include much of what is commonly considered to be the natural, social and behavioral sciences, and it is precisely for this reason and to this extent that these areas of knowledge are purely related to the subject matter of mathematics education. The inclusion of the words method and observation, places stress

upon the dynamic nature of the knowledge that is mathematics education. As long as more research are utilized on the methods of mathematics, suggestions should be made that Mathematics is dynamic not statics, both in principle and in practice. Mathematics education defined this way, clearly shows that its practice is a human activity. Human beings do the observation, employ the methods and gain the body of knowledge, Olarinoye, (2009). This is in line with fallibilists's philosophy. The fallibilists conceived mathematics as a dynamic, continually expanding field of human creation and invention, a cultural product, a process of enquiry and coming to know, not a finished product, for its results remains open for review (Ernest, 1994). Therefore, therefore, the role of a fallibilist as a teacher is to make students confident problem posers and problem solvers. Clearly, the philosophical stance of the fallibilist teacher is that of a facilitator. There is no doubt that if one conceives mathematics as dynamic and continually expanding field of human creation and invention, then to put this into practice, it is necessary for him to deviate from the traditional approaches of teaching (as in the case of absolutist conception, see Ernest, 1991). Furthermore, with this conception of mathematics the roles of the teacher, the learner and the learning environment must also be necessarily different in order to meet the new challenges. Under this construe, mathematics is now seen as dynamic, warm, human, personal, active, collaborative, creative, investigational, cultural, historical, living, related to human situations, enjoyable, full of joy, wonder, and beauty (Ernest, 1996).

Conceptualizing Mathematics Education

Mathematics education is defined variously by educationist. But for this presentation we prefer the one given by Wikipedia (2017) as "the field concerned with **s**haring mathematics contents and processes with individuals not traditionally considered part of the mathematics educators' community. The learners' may be children, college students or adults within the general public; the field of mathematics education includes work in mathematics education content and mathematics processes, including pedagogy (Wikipedia, 2017). It further explained that the standards for mathematics education provide expectation for the development of understanding for students through the entire Mathematics education courses.

Education encompasses all the processes of facilitating learning; the processes of acquisition of knowledge, skills, values, beliefs and habits. Mathematics education includes storytelling, discussion, teaching and directed research. Brands *et al.,* (2005) summarized massive research into students' thinking as having three key findings:

- Preconception;
  Prior ideas about how things work are remarkably tenacious and an educator must explicitly address a student's specific misconceptions, if the student is to configure his misconception in favor of another explanation.Therefore, it is essential that educators know how to learn about students' perceptions and make this a regular part of their planning
- Knowledge organization;
  In order to become truly immersed in an area of mathematics education, student must:
  (a) have a deep foundation of factual knowledge (b) understands facts and ideas in the context of a conceptual framework and (c) organize knowledge in ways that facilitate retrieval and application (Layton, 1981).

- Metacognition;

Students will benefit from thinking about their thinking and their learning. They must be taught ways of evaluating their knowledge and what they don't know, evaluating their methods of thinking, and evaluation their conclusion.Educational teaching methodologies are to be refined to meet the specific needs of mathematics students. This is due to the fact that the national policy on education (2014) stated clearly that the goals of primary and secondary education respectively include; to lay a sound basis for Scientific and reflective thinking, provide trained manpower in the applied Mathematics, Science, technology.

Although the policy put mathematics among the prerequisite courses for the attainment of the stated goals,unfortunately, in spite of all interventions by various governments, educational support programs such as NIPEP,GPE, MDG, TET fund etc, the reality is, the students' apathy to mathematics (Kano State Ministry of Science and Technology, M.O.E.S.T, 2016). Research works by (Milner *et al* (2006), Kola (2013), Abdullahi (2013) and Christopher (2015) showed low student's enrolment and depreciating performance in mathematics.

How then do we address these poor attitudes of the public (including students and the none mathematics populace) in our dear nation towards mathematics? How also do we resolve the mathematics Myths-that mathematics is for the specially trained people? The possible remedy that may likely curve away this menace is here by discussed;

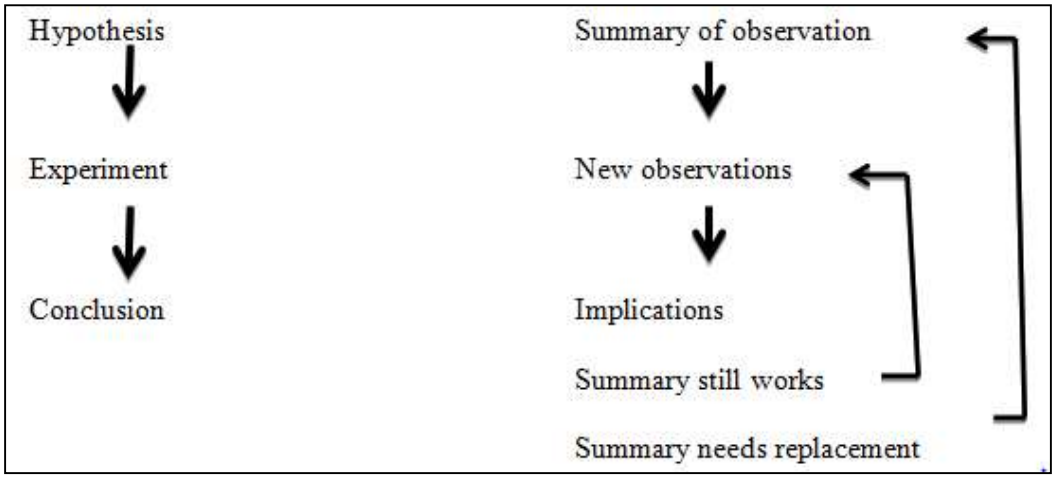
Grobstien, (2003) observed that in this 21st Century, a gap and tension costly to both of us continue to exist between those who engaged **(**comfortable) with mathematics and those who are not, both inside and outside the academia. This split is an illustrative of significant ethical and moral ambiguities in "mathematics" as it is generally understood. Mathematics educators have a compelling responsibility to see these ambiguities clarified for the sake of human culture of which mathematics is a part of. One problem viewed as the most important target for mathematics educators to address in the 21st Century is probably: To clarify the best and most fundamental aspects of mathematics so as to make mathematics a comfortable an acceptable part of the shared common story of all human beings. To achieve this, there is the need to find ways of reducing the perception of mathematics (by both those engaged actively in it and those not) as a specialized and isolated activity of the few, and create the kinds of bridges that will more effectively link mathematics not only to other academic disciplines, but also to the non academic worlds as well.

This can be done without requiring any compromise in the core values of the mathematics enterprise itself. Instead, it is required of mathematics educators only the kind of self-examination and clarification of these core values that mathematics education (like all human activities) needs to engage in periodically for its own health and the deliberate consideration of mathematics educational objectives and strategies in that light:

Mathematics as Endless Self-Correcting Discipline

A comparison of two ways of describing the "Mathematics methods" can help to illustrate the kind of clarification of the core values of mathematics that is believed to be important to building more effective bridges between those currently comfortably

engaged with mathematics and those who are no (Duit, Niedderer and Shecker, 2007):

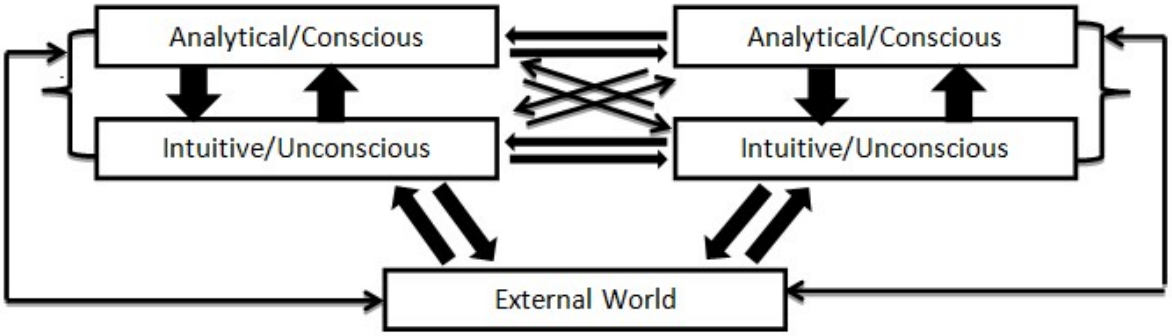


Hypothesis is true (Hypothesis is not true): To the left, is a common description of the "mathematics method" the words used (particularly "hypothesis" and "experiment") convey the impression that mathematics is a specialized activity carried out only under special circumstances, by specially trained individuals. The diagram also implies that mathematics is exclusively a rational (analytic) process that runs unerring in one direction and yields "truth" as its outcome.

To the right – is an alternate characterization of "mathematics method" one used by some educators and believed not only makes mathematics more accessible and engaging to all humans but also reflects more clearly and openly how mathematics actually proceeds, the alternate characterization equates "hypothesis" with "summary of observation" an activity that is done by all human all the time, beginning from birth and which always includes intuitive and imaginative ingredients. "Experiment is equated with" new observation" again a common activity of all humans, and one which is frequently enjoyed (as in playing). Most importantly, the alternate characterization makes it apparent that the process is not linear and does not yield "truth". Instead, it involves a perpetual loop, a continual and unending process of making observations summarizing them, and revising the summaries based on new observations of telling and retelling stories to get them not "right" but"less wrong". It is actually this last characteristic skeptically, rather than any specialized knowledge or training or truth claim, which gives mathematics most of its progressive direction and power (Ernest, 1991 and 1996).

Mathematics as Collective Story – Telling:

Endless Self – correcting story telling is one component of essential core of Mathematics as it is actually done. The other is the communal nature of the process (Duit, 2006).



We are all of us (both those currently engaged with mathematics and those not constantly engaged in a process of self-correcting story – telling in which our intuitions interact with our observation of the external world, of other people, and of ourselves. Consider that our ancestors have been so engaged through many Millennia in mathematics in their unique processes, what we have relatively recently learned to do is to amplify and accelerate those processes by actively sharing it with other individuals. This too is by no means unique to mathematics; it is what we mean by culture. Nonetheless, it is worth making explicit that this common process is a second essential component of mathematics and its power. As mathematics educators, we benefit enormously from not having to do all the story telling observing and story – telling as individuals; instead we share both observations and stories with each other and from that sharing emerge more rapidly common stories "less wrong" than any of us could create alone.

Identifying the Central Needs for Change:

At its core, Mathematics is not only a human activity but a human activity which could come to be seen as the common property of all human beings: the ongoing writing and rewriting of a common story to which the observations and stories of all individuals make valued contributions. Beyond making clear the actual nature of mathematics, this description helps highlight two additional challenges to completing the task of bridging the "two cultures" gap (Gills, 2013). One of these challenges is a matter that depends largely on changes within the existing "mathematics educators community," indeed it requires a willingness to change the very definition of "mathematics educators community" Mathematics educators like all human beings, have a tendency to "tribalism" an inclination to share observations and stories only with people who are in some sense"like themselves" The main problems with tribalism isn't so much whether members of a tribe are willing to make their observations and stories available to people outside the tribe (which they frequently are) but whether they are also willing to listen to the observations and stories of others, with the potential that those change their own in turn.

The mathematics educators' community does not have distinguished records of this latter kind of engagement, and hence it tends by its own tribalism to encourage tribalism in others. If mathematics is actually to become the common property of humanity, mathematics educators themselves are going to need to learn to transcend their own tribal inclinations, to not only entertain the possibility that the observations and stories of people currently outside the community

are relevant, but to begin actively valuing them to genuinely open the "mathematics educators' community" to all comers. This will not be easy, but it is in fact very much in line with the core values of mathematics. There is nothing (except perhaps a spurious "efficiency") to be gained for mathematics by denying the potential relevance of observations/stories whatever their origins, and there is a lot to be lost both in the potential improvement of stories and in the desirable reduction of tension and mistrust.

The other challenge to successfully bridging the two cultures by sharing the ongoing writing and rewriting of a common human story is a reluctance to give upon the idea of "truth" and accept in its stead a commitment to an ongoing process of "getting it less wrong." knowing "Truth" or at least believing one is on the "right" path to finding it, is a sources of comfort and security to many of us, both within and outside the current mathematics educators' community (John, 2013). But differences in conceptions of "Truth" or of whether and how it is to be found are at the root of the existing "two cultures" gap as of much of human conflict, mistrust and tension generally. Moreover, mathematics as the collective and ongoing need the concept of old stories in the light of new observation. It will not be easy to persuade people to give up "Truth" as a guide and aspiration, and replace it with an appreciation, perhaps even enjoyment of continuous progressive change. But that is at the core of what mathematics and is all about. Helping others come to understand that it is as best, one can tell what life is all about as well, may be the single greatest contribution mathematics can make to the future of humanity (John, 2013).

Making the abstract concrete: Mathematics in the 21st Century

- We need to continue making progress in teaching (and understanding) as a hands-on interactive process
- We need to make greater progress in teaching (and understanding) mathematics as "getting it less wrong"
- We need to further after both the perception and the culture of mathematics itself to invite all students (all humans) into an ongoing and shared process of telling, listening to and modifying stories.
- We need to help students (all humans) learn appreciate and even enjoy participation in the process of end less some what unpredictable change.

Toward these ends we should:

1. Make greater use of past and ongoing exploration of the nature of understanding itself (including cognition, learning and the brain). These should both under pin pedagogical practice and become a central focus of curricula.
2. Continue to help shape and to learn to make effective use of the World Wide Web as the closest approximation yet to an optimal educational environment rich enough to be responsive to individual needs, able to support interactive learning, supportive of student as initiator/participant, and representative of a brand-base human community.
3. Redesign curricula to present mathematics not as an isolated and distinct-sphere of educational experiences, one that bears on broad question of concern to all, and that is in turn influenced by other approaches to such questions. Rather than designing curricula primarily to attract and train "Mathematics educators" we should design them primarily to engage all

students with Mathematics, and develop supplementary, specialized curricular for those aspiring for professional careers in Mathematics and Science educations.

“Getting it less wrong" as a Guide to Professional Ethics and Morality:

In the proceedings, focused was made largely on educational issues because it has been believed (Grobstein, 2013) that education is the most reliable route to genuine and meaningful systematic change. It is worth though calling attention, at least briefly to the implications in the existing mathematics educators practice of thinking seriously about mathematics as endless, self-correcting, collective story telling.

Fraud and misrepresentation of mathematics educators’ findings would be regarded as being as disruptive of the process conceived in terms of "getting it less wrong" as they would of it conceived in almost any other way. One also normally stresses in considerations of the ethics of mathematics, free and open exchange of information and the collective "getting it less wrong" perspective would if anything, make this an even stronger mandate.Where things get interesting and significant, it is in connection with issues where most current conceptions of mathematics ethics provide less certain guidelines to behavior. The “getting it less wrong” perspective for example, might deny the use of the term "mathematics" (and the associated implied endorsement of mathematics educators’ community) to research that is carried out primary to prove that something is so, and or to further commercial objectives.

To put it differently, the perspective would encourage thinking about distinguishing between "research" (which may be done for a variety of reasons some legitimate and some perhaps less so) and "Mathematics" and endorse (or defined) only the later. A failure to make this distinction has repeatedly put mathematics in an ethically awkward position in recent years, particularly in connection with biomedical research. The "getting it less wrong" perspective might also preclude the problematic tendency of contemporary mathematics to lay claim to social resources on the grounds that it will in the near term alleviate human sufferings or provide solutions to other human problems. Such claims provoke increasing (and appropriate) skepticism in the political and social arena as it becomes clearer and clearer that mathematics educators’ progress bears no simple relation to human well being. And this is in evitable. It is not the business of mathematics to affirm or comfort or "fix". The latter may occur as a byproduct of mathematics (and frequently has) and the first two may perhaps as well, but the primary business of mathematics is to question and challenge. It is dishonest and will ultimately be counter-productive to try and "sell" mathematics any other way.

Perhaps the oldest and most persistently problematic ethical ambiguity in contemporary views of mathematics relates to the question of the degree of responsibility that mathematics educators have for the social consequences of their activities. Conceiving of mathematics as the pursuit of "truth" or of short-term human well being permits mathematics educators a posture either of moral and ethical "neutrality" or of assumed virtue neither carefully thought nor genuinely earned.
Recognizing mathematics as a process of the continual collective rewriting of stories requires instead that the "players" be continually wrestling with the justifications (or lack thereof) both for the institution of

playing and for the consequences of their own doing so.

Collective "getting it less wrong" embeds mathematics in the human community from which it derives and from which it has, of course never actually been separate. It also potentially gives mathematics clear set of ethical mandates (or reveals a usually hidden and often ignored set) which includes those mentioned together with a deep respect for the importance of diversity. Mathematics as collectively "getting it less wrong" recanted mathematics in the human community from which it derives and from which it has of course never actually separate. Mathematics as collectively "getting it less wrong" thus raises itself as a moral system, one which has, by virtue not only of its products but also of its own character, a substantive role to play in the ongoing evolution of the human story of meaning and purpose.

CONCLUSION AND RECOMMENDATIONS

The view that mathematical truth is fallible and corrigible, and can never be regarded as beyond revision and correction, is the fallibilists philosophy which is gaining ground in this 21st century to the detriment of the absolutist's traditional view of mathematics as an objective, absolute, certain and incorrigible body of knowledge which is based on the epistemology of logical positivism. In line with this, the absolutists also believed that the foundations of mathematical knowledge are not in any sense, of social origin but lies outside human actions, Yushau *et al*., (2004). This school of thought conceived mathematics as being abstract, consisting of immutable truth and unquestionable certainty which should be removed from human influences and the everyday life context (Ernest 2016).

To the fallibilists, mathematics as a human activity, is too big and too important to be left in the hands of few individuals who claim its ownership to the detriment of the entire human race.Strategies for reducing the perception of mathematics (those engaged with it and those not) as a specialized and isolated activity of the few, and thus,create the kinds of bridges that will more effectively link mathematics and mathematics educators to the none academic world as well, were highly illustrated in the text. To this end, the paper recommends among others that mathematics and mathematics Education Curricula should be redesigned to present "mathematics" not as an isolated and distinct sphere of educational experience, but one that bears on broad concerns of all rather than designing curricula to train mathematics educators, but to engage all students with mathematics education and develop supplementary specialized curricula for those aspiring for professional careers in mathematics. Research work should be conducted to identify the effective ways for actualizing this proposal.

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