INTEGRATING TECHNOLOGY INTO MATHEMATICS EDUCATION IN NIGERIA: THE CASE OF GEOGEBRA

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Introduction

"Computer technology is currently easily accessible and becoming a popular teaching tool to the extent that technological literacy is now perceived as a basic skill of teaching" (Lawless and Pellegrino, 2007; Mainali and Key, 2013). The importance of using technology in Mathematics education has been emphasized by the National Council of Teachers of Mathematics (NCTM) because technology can have a crucial role in teaching and learning of Mathematics; it both influences the Mathematics that is taught and enhances students' learning (NCTM, 2000). Educators presently realize that computer literacy is an important part of a student's education. Integrating GeoGebra, software into a course curriculum when appropriate is proving to be valuable for enhancing and extending the learning experience for faculty/school and students, (Olalere, 2013).

> "The computerized nature of the global world has led to the intensification of the use of computer in teaching many of the topics in Mathematics. Hence, a lot of computer assisted instructional materials are recommended for the teaching and learning of various topics", (FME, 2007).

Moeller & Reitzes (2011) noted that, as the principles guiding student-centred learning become more defined (Bruner, 1961), increased attention is being paid to the tools and resources best suited to its successful adoption. On the surface, technology would seem to offer a natural - and accessible - way to advance student-centred learning, (Bruner, 1961). "After all, in today's public schools (in Quincy, USA), there's an average student to computer ratio of 4:1 and a teacher and student population ready, willing and able to use technology", they added. Yet despite its availability, technology is not widely integrated into the learning experience. "A recent survey of more than 1,000 high school teachers, IT staff and students shows that only 8 per cent of teachers fully integrate technology into the classroom. Not surprising, 43 per cent of students feel unprepared to use technology as they look ahead to higher education or their work life", they further stated.

Meanwhile, technology, according to Mapaderun and Raimi (1998), is derived from the Greek "*teclure*" meaning "art" or "craft". In the broader sense it refers to all processes dealing with materials, while in the narrow sense, it refers to the industrial processes that succeeded craft operation. "Technology can then be

defined as the application of scientific knowledge to provide solutions to human problems", they added.

The Potential Technology Offers

Because technology is both highly customizable and intrinsically motivating to students, it is particularly well-suited to expand the learning experience. To date, research on the effectiveness of technology has focused primarily on higher education and professional development, yet it suggests that specific uses of technology can improve primary to secondary students' outcomes as well. In line with the findings of Moeller & Reitzes (2011), there are indications that GeoGebra and technology at large can:

Help diagnose and address individual needs. Technology can equip teachers to assess an individual student's strengths and needs. Two main approaches to technology-supported assessment exist. One is a mastery learning approach tied to accountability systems. This enables teachers to benchmark students as they progress through a standards-based curriculum. The other assesses understanding which produces a picture of student thinking. Both approaches help establish a clear baseline from which teachers can then serve as coaches and advisors, steering students to the right mix of resources and projects that meet curricular requirements, (Bruner, 1961).

Equip students with skills essential for work and life in a 21st century global society. Using technology for purposes, such as writing, research and analysis - rather than simply drills and practice - can enhance student competencies that surpass the knowledge and skills typically measured in achievement tests. These competencies include problem solving, creativity, collaboration, data management and communication. Many employers find these skills lacking among today's college graduates. In addition, a number of organizations ranging from the Partnership for 21st Century Skills to the U.S. Department of Education see literacy in digital media as essential for succeeding in a global society.

Provide an active experience for students. Technology can equip students to independently organize their learning process, (Bruner, 1961). So, instead of being passive recipients of information, students using technology become active users. At the same time, technology transfers some responsibility for learning to students. Through online learning (which provides increased access to course content, more scheduling flexibility, and better access to alternative education choices) and alternative media (such as digital games and project-based learning), students have the flexibility to direct their individual progress.

Others include:

- Technology can support key practices of student-centred learning, (Bruner, 1961). For example, emerging technology already prevalent in the consumer and business worlds (such as digital books, cloud computing, collaborative environments, and mobile devices).
- Technology, if rightly done, provides an invaluable way to deliver more personalized learning in a cost-effective way.

- Technology provides high-quality, on-going feedback to teachers and students that can help guide the learning process. And when technology mirrors how professionals use it in the workplace, it can enhance academic achievement, civic engagement, acquisition of leadership skills, and personal/social development.
- Technology can be designed to provide adaptive learning and assessment experiences for students. Most important to student-centred learning (Bruner, 1961), technology can enable outcomes that vary based on students' strengths, interests, and previous performance.

Raji (2011) also highlighted some roles of ICT facilities in the teaching and learning of Mathematics, they include to:

- Arouse students' interest in Mathematics;
- Build on students' experience and knowledge;
- Strengthen students' problem solving skills and reasoning abilities;
- Make the curriculum coherent and compatible with known relationships and sequences of important mathematical ideas;
- Introduce Mathematics instructional activities;
- Provide opportunities for students' deep and sustained interaction with key mathematical ideas;
- Integrate Mathematics with other activities and other activities with Mathematics.

Preiner (2008) agreed that new technology has become a very important factor in everyday life since few decades ago. Nowadays, computers are vital for business and economy and 'computer literacy' is considered as a very important skill in our society. For instance, for young people who have grown up having access to computer technology at home, computers have become common tools for information, communication, text processing, and playing games, among others. Besides, the development and rapid growth of the internet in combination with its increasing accessibility for the public has opened up a whole new digital world.

Lawless and Pellegrino (2007), and Preiner (2008) revealed that several educational organizations have started to develop technology-related standards, while trying to foster the integration of new technology into teaching and learning, knowing about the increasing importance of new technologies for everyday life. "Technology is essential in teaching and learning Mathematics; it influences the Mathematics that is taught and enhances students' learning" (NCTM, 2000).

Students can benefit in different ways from GeoGebra integration into everyday teaching and learning of Mathematics. New learning opportunities are provided in technological environments, potentially engaging students of different mathematical skills and levels of understanding with mathematical tasks and activities (Hollebrands, 2007). Additionally, the visualization of mathematical concepts and exploring Mathematics in multimedia environments can foster their understanding in a new way, Van Voorst (1999). Preiner (2008) reported that technology was "useful in helping students view Mathematics less passively, as a set of procedures, and more actively as reasoning, exploring, solving problems, generating new information, and

asking new questions." She therefore claimed that technology helps students to "visualize certain Mathematics concepts better" and that it adds "a new dimension to the teaching of Mathematics".

Technology environments allow teachers to adapt their instruction and teaching methods more effectively to their students' needs (NCTM, 2000). By integrating educational tools into their everyday teaching practice, those teachers can provide creative opportunities for supporting their students' learning and fostering the acquisition of mathematical knowledge and skills. Gifted students can also be supported more effectively than ever by nurturing their individual interests and mathematical skills. While the weaker students can be provided with activities that meet their special needs and help them to overcome their individual difficulties (Preiner, 2008). ICT has almost taken over everything a man does on earth. It has been seen to have a revolutionary impact on Mathematics methodology and education in general, Fadare (2012).

Finally, students can develop and demonstrate deeper understanding of mathematical concepts and are able to deal with more advanced mathematical contents when GeoGebra is involved than in 'traditional' teaching environments (NCTM, 2000).

The Challenges to Overcome

Integrating technology into educational practices has proven to be a slow and complex process. In fact, it can take four or more years from the time new technologies are first introduced to the point when changes can be observed in students. Presently, the most prevalent barriers to successful integration include organizational support, teacher attitudes and expectations, and technology itself (Moeller & Reitzes, 2011).

School culture and structure don't support specific uses of technology. Often, technology is not aligned with a school district's vision, mission and curriculum. As a result, there is no foundation in place to provide consistent access to - and use of - technology throughout the primary & post primary years. Using technology to support student-centred learning requires leadership, administration and the community to collaborate and set an agenda for technology that reflects local needs, focuses on a common set of learning standards, and connects students to real-world audiences.

Most teachers lack confidence in technology as well as their technology skills. According to a National Centre for Education Statistics study, only 23 per cent of teachers' surveyed feel prepared to integrate technology into their instruction. Those who use technology do so primarily to present information rather than to provide hands-on learning for students. Some are unclear about policies governing the use of technology. Others are uncomfortable with investing instructional time to deal with possible equipment failures or slow Internet access. Clearly, more of an

investment in technology training and technical support needs to be factored into primary and post primary funding and resource allocation (Moeller & Reitzes 2011).

Moeller & Reitzes (2011) thereby concluded that while technology can provide a powerful teaching and learning tool, it cannot drive reform on its own. To be widely adopted, technology must be part of a comprehensive and systematic effort to change education.

Precautions in Using Technology in Teaching and Learning

According to Fadare (2012), the following consideration may be used by schools and teachers to guide their decisions regarding Mathematics and technology:

Students require a strong foundation in basic skills. Technology does not replace the need for all students to learn and master basic Mathematics skills. All the students must be able to perform simple calculation easily without the use of calculators or other electronic tools. The students' use of technology must build on these skills and understandings; it is not a substitute for them.

Technology should be used to promote Mathematics learning. Technology can help promote students' understanding of mathematical concepts, quantitative reasoning, and achievement when used as a tool for solving problems, testing conjectures, accessing data, and verifying solutions. In addition, students can exchange ideas and test hypotheses with a far wider audience through the internet. Technology makes Mathematics more accessible and allows one to solve mathematical problems with speed and efficiency. Technology may also be used to reinforce basic skills through computer-assisted instruction, tutoring systems, and drill and practice software.

The focus must be on Mathematics content. The focus must be on learning Mathematics, using technology as a tool rather than as an end in itself, for technology supports is not a substitute for the development of quantitative reasoning and problem-solving skills. However, technological tools cannot be used effectively without an understanding of Mathematics skills, concepts and relationships. As students learn to use electronic tools, they must also develop the quantitative reasoning necessary to make full use of those tools. They must also have opportunities to reinforce their estimation and mental Mathematics skills and the concept of place of value so that they can quickly check their calculations for reasonableness and accuracy.

Fig.1 Field Experience

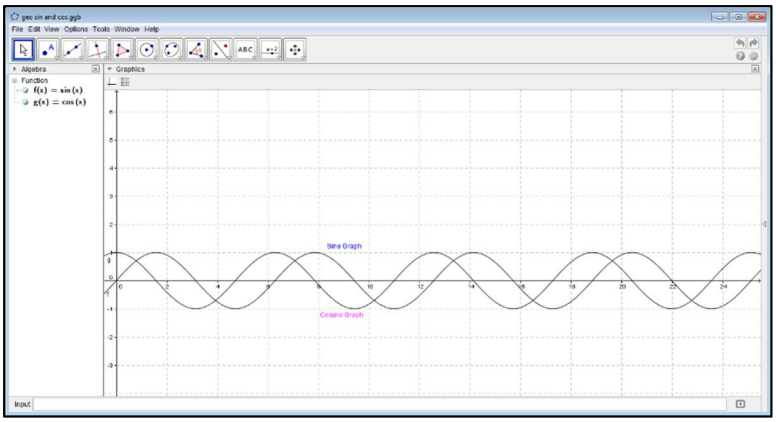

Fig.2 Sine and Cosine Graphs

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Websites

GeoGebra – Free download: *http:/www geogebra.en.softonic.com*

GeoGebra User Forum*: http://www.geogebra.org/forum*