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Influence of Mathematics Education on Students' Creativity Skills for Sustainable Development

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Abstract: *Development is growth in the positive direction projected to bring about self improvement in the life of the individual, economic, infrastructural, science and technology, national development, and social transformation of the society. What students learn goes a long way in influencing positive changes into their lives for a better standard of living in the future. The study investigated the influence of Mathematics Education on students' creativity skills as a yardstick for sustainable development. The paper discussed the influence of Mathematics in various aspects of human lives. The paper opined that Mathematics Education provides individuals with knowledge, critical thinking ability, problem solving techniques, adequate skills, and creativity needed to enable one face life challenges. The paper concluded that Mathematics Education is a veritable and indispensable tool for societal transformation and sustainable development.*

Keywords: Mathematics Education, Creativity Skills, and Sustainable Development.

INTRODUCTION:

The philosophy of education especially in Nigeria is geared towards the development of the individual for self-reliance, economic, political, infrastructural, scientific and technological development. Education is adjudged an instrument par excellence for actualizing sustainable development, and is therefore needful in building a sustainable society. Education paves way for good governance in all spheres of life. Education is a tool for transformation and a wherewithal of developing qualities in building a rich and satisfying life (Muhammad, Yusha'u &Lawal, 2018). Mathematics is the science of numbers that develops in the mind of the learner the ability to reason, as well as think critically and systematically in problem solving. Mathematics is the foundation of knowledge and an indispensable tool in fostering creativity that helps with finding innovative solutions to the challenges and issues of human existence. Mathematical knowledge is expressed in our day-to-day living, whose influence is seen in the fields of natural science, engineering, medicine, agriculture, politics, and science and technology, which make for sustainable economic growth and development (Guwam, 2017). Mathematics education entails developing the teaching and learning of the subject, and the pedagogies applied in its teaching to maximize its influence on the learner and, by extension, the society. A mathematical competency is a teacher's readiness to act appropriately in proffering solutions to mathematical challenges. When a teacher lacks digital skills, he lacks full engagement with education and this, acts as a barrier to teaching and learning. There is therefore need for the government to invest into training teachers to develop mathematical digital competency, as well as upgrade the curriculum to capture the prevailing societal challenges, into Mathematics teaching (Geraniou, E., Jankvist, U. T., Elicer, R., Tamborg, A. L., & Misfeldt, M. 2022). According to Anyagh et al, (2018) in Idehen, F.O. & Ofuonyebuzor, P.A, (2024), teachers should effectively integrate technology into the mathematics classroom by ensuring that they use technological tools to facilitate learning as they create mathematical tasks that take advantage of what technology can offer.

Sustainable development is a total development of a nation. It is the degree to which a nation is able to build her economic, political, infrastructural, and technological ideas to harness progressive changes in the quality of life of her citizens. Development is the collective activities by any human society projected at minimizing the totality of perceived challenges of human existence, to a better and higher living standard of her citizenry. Development is progress integrated into the economic, political, scientific, and technological base of any nation. Development is a social transformation of the society evidenced in high literacy and numeracy rate, bumper agricultural productivity, high technological growth, appropriate health care delivery, low unemployment and high standard of living of the citizenries (Nkwocha, 2016; Charles – Ogan & Agomuo, 2017). Development in any nation begins with the equipping of the individuals of such a nation. The implication is that the knowledge, skills and creativity that influence the human resources, is a function of the extent of progress for sustainable development of that nation. Through the teaching of Mathematics, Knowledge, critical thinking, skills and creativity transform peoples' potentials into human capital. This implies that a nation that offers the right kind of Mathematics education (with the right curriculum) is well able to meet up with the ever changing demands of a changing world. Influence is the capacity to have an effect on the behavior, development, or thinking of someone.

Mathematically, influence can be exerted through persuasion or by providing information and ideas that shape critical thinking, creativity, decisions and actions that profile answers to problems. There should therefore be interconnectedness between Mathematics education and development that can influence sustainability (Chen, Ling, Ma, Wen, Gao, & Gu, 2020).
Creativity skill is the ability of an individual to do something new through training acquired, and doing it well. It is the ability to use identified ideas to communicating with others to generate alternatives or possibilities in solving problems. Kurumeh and Dogo, (2015) made it clear that creativity is the use of one's imagination that goes with the act of creation. In order to achieve this, the capacity to think creatively should be harnessed in students, in shifting from what students know to what students are able to do with what they know as they showcase their competence in contributing their quotas to the development and progress of the nation at large, since the challenges of the 21st century with its diverse innovations in science and technology, economic, infrastructural, and political exertions demands that students should be creative, innovative and enterprising.

Therefore, countries that are growing-up in education, economy, infrastructure, human resource, and living standard are said to be developing, and counted among the developing countries in the world (Effiom, 2017; Blessing & Peter, 2019). Nigeria, if not for bad governance, ought to be counted among the developed nations of the world with all the available natural and human resources she possesses (Akinyetun, 2016). In other to foster and encourage national sustainability in the nation, UNESCO (2017) promoted ESD education. Education for Sustainable Development (ESD) is an approach to teaching and learning that integrates key sustainable development issues into teaching and learning aimed to empower learners from all spheres with creative skills and ideas that will spur them into taking actions that will bring transformative changes in building and upholding sustainability. ESD prepares people on how to plan, cope and find solutions to global challenges such as climate changes, biodiversity loss, poverty, and social inequality that may likely threaten the sustainability of a nation; it encourages positive behavioral changes that influence a culture of sustainability, resilience, and respect for human and its environs (Gisela and Merce, 2015). Opining to this, the FRN established technical colleges where mathematical theories will be put into practical realities to turn out graduates who will be highly appreciated and valued in the labor markets. Technical colleges are educational institutions designed to prepare students to acquire basic scientific knowledge, practical skills, and mathematical attitudes needed for craftsmanship at diverse levels of professions (Akpan, 2007 in Oviawe and Anaele, 2019).
Series of researches have been carried out to find lasting solution to the challenges of sustainable development in Nigeria. Many researchers believed that Mathematical knowledge has vital influence in the development of a nation (Alio and Okafor (2015); Emeke and Richard (2017); Timayi et. al, 2017).

The topic "The place of Mathematics Education on students' creativity skills for sustainable development" would be discussed under the sub-topics:

1. **The role of mathematics in Individual Development**
2. **Mathematics and Economic Development**
3. **Mathematics and the Development of Science and Technology**
4. **Mathematics and Living Standard**
5. **Sustainable Education and National Development**
6. **Usefulness of Mathematics Education in Sustainable Development**
7. **Challenges of Mathematics Education Towards Sustainable Development**
8. **Conclusion**

The role of Mathematics in Individual Development

Mathematics as a subject is very important in building intellectual capacities in the individual. Hence it is made compulsory at the primary and secondary levels of education (Davis, Beccles, & Intsiful, 2019). Mathematics harnesses in the individual the ability to think critically, reason logically, and do things constructively and creatively. These, equips and enables the individual to enumerate, measure, calculate, and analyze quantities. For example, a farmer is able through the knowledge of Mathematics to critically, creatively, and logically design the quantity of seeds he will plant to give him the harvest that he desires (Obi, Abugu, & Ayogu, 2018). According to Olukemi & Gbenga, 2016; Ladele, 2017, Mathematics inculcates in the individual the spirit of perseverance, a strong self-will power, and self-dependence in any field of endeavor, as it plays significant roles in the social-cultural life of the individual in areas such as; inter-personal relationships in business, security, food production and preservation, and industrial development (Charles-Ogan, 2014). Ladele (2017) & Obi (2018) opined that the positive transformations in social structures with regards to technological facilities such as mode of transportation, means of communication and progress in the field of science and technology are due to mathematics. In this way mathematics plays an important role in not only understanding the progress of society but also developing the society to another mode called global village.

Mathematics and Economic Development

Technological changes in the modern day world are anchored totally on Mathematics. Mathematics is an indispensable tool needed in all aspect of human and national development. This is so because every subject especially the sciences borrow leave from Mathematics. Science and technology are the driving forces that foster economic development in any nation. Industries of modern day times depend on science and technology for its innovative ideas for enhancement (Wasagu, 2019). Science and technological support are necessary because they lead to economic benefits through improved industrial processes and products. This is why western worlds invest huge funds in research and development in Mathematics education especially in the sciences. This investment is seen as strategic because of the importance of these disciplines to national development. Economy and technology are interwoven; one cannot develop without the other. The enhancement of the economy of any nation is a function of the extent of the mathematical knowledge possessed by the citizens, which in turn, spurs up technological development of the nation (Effiom, 2017; Guwam, 2017). In agreement with this, Etukudo, 2017; & Guwam, 2017 opined that mathematics is an essential tool that proffers solution to issues of economics recession and challenges, as it plays important and significant roles in economic development in times of recession, especially in allocation of resources and making scale of preference.

Mathematics and the Development of Science and Technology

Mathematics is an essential tool of science and technology which reveals hidden concepts that help man to understand his environment. Mathematics is the parlance and strength of science and technology (Akissani & Muntari, 2015; Chianson, Aligba, & Azuka, 2016). According to Roohi (2014), Mathematics through the applications of science and technology finds expression in the fields of medicine such as epidemiology, DNA and genetics technology, manufacturing of medical equipments, and diagnostics electronics and sensor technology, scientific researches in the Biological and physical sciences. Science is the systematic study of natural phenomena through hands-on-activities. Technology is a by-product of science and it is the application of scientific theories and skills into real life situation (Clement, & Sunusi, 2017). According to Nwigboji and Egbe (2017), technology is the systematic study of the processes, techniques, skills and procedures apply in transforming our environs for quality living standard.

In the utilization and mastery of modern science and technology, the difference between developed, developing and underdeveloped nations cannot be compromised. This means the degree of standard of living, economic growth, health care delivery etc of a nation depend on the level of science and technology of that nation. Nowadays the system of education has been modernized with the scientific and technological innovation. Therefore, to develop scientifically and technologically, a nation must have a sound base in mathematics; the bedrock of science and technology. As a developing nation, Nigeria is therefore encouraged to enhance its Mathematics education to meet up with the basic requirements for development globally.

Mathematics and Living Standard

Mathematics is applicable in every aspects of human life. Mathematics plays a crucial role in determining and improving the living standards of individuals and societies. According to Obi (2018), Mathematics has influenced developments in various areas. Economically, mathematical models are used to analyze market trends, make investment decisions, and formulate policies that can lead to economic growth and stability. In research and development, Mathematical influences have found application in analyzing data, making predictions, and optimizing resources. In technology, mathematical algorithms are used for developing efficient processes, creating innovative products and enhancing communication networks. In healthcare, Mathematics is applied in medical imaging, drug development, and epidemiology to improve diagnostics and treatment strategies. Moreover, in education, Mathematics is essential for building critical thinking skills, problem-solving abilities, and logical reasoning, which are vital for personal and professional development. This makes a better quality of life for individuals and communities living in the society (Smith & Harriet, 2021).

Sustainable Education and National Development

The concept of sustainable education and development has become a major concern to the governments as well as educationists in recent times. On daily bases, human population and the demands by man is exponentially on the rise in the nation. Due to the increase in the populace and in demands, advancement in Agriculture, politics, economics, as well as technology, become necessary to meet these demands. Literarily, the word ‘sustainable’ means something that has the tendency to continue; something that is capable of being maintained within a given standard. Sustainable national development is the ability of a nation to economically, politically, socially and technologically achieve comprehensive growth in all spheres of its existence both now and in the future. In attaining sustainability, education clearly identifies areas of information, integration, and participation as foundation to support countries, achieve the needed development. For meaningful sustainable development, education equips individuals on the usage and management of information in changing from the old pattern and adapting to the new pattern of doing things that will make for growth and development in the society.

Sustainable education and national Development is education that influences changes in knowledge, skills, principles, and human dispositions to enhance a more sustainable and fair society for all and sundry. According to UNESCO (2017), sustainable education and national development entails poverty eradication, decent work and economic growth, hunger alleviation, good health care deliveries and all-round well-being, quality education, gender equality, good water and energy supply, industrial revolutions, innovative and infrastructural developments.

Sustainable education plays a vital role in fostering national development by equipping individuals with the knowledge and skills needed to contribute effectively to society. Sustainable education goes beyond traditional academic learning and encompasses teachings on environmental awareness, social responsibility, and economic empowerment. By emphasizing sustainability, educational institutions can prepare individuals to address current and future challenges, such as climate change, resource scarcity, and social inequality.

One of the key aspects of sustainable education is its focus on creating a well-rounded curriculum that integrates principles of environmental stewardship, social justice, and economic prosperity. By incorporating these elements into various subjects, students are better equipped to understand the interconnectedness of global issues and develop innovative solutions. Furthermore, sustainable education promotes critical thinking, creativity, and collaboration - skills that are essential for driving progress and fostering sustainable development on a national scale. In order to achieve sustainable education and realize its benefits for national development, it is essential for policymakers, educators, and stakeholders to collaborate and prioritize long-term investments in education systems. This includes updating curricula to incorporate sustainability principles, providing professional development opportunities for teachers, and leveraging technology to enhance learning outcomes. Research has shown a strong correlation between sustainable education and positive outcomes for national development. Studies have demonstrated that countries with a focus on holistic education and sustainability tend to have higher levels of economic growth, social equity, and environmental protection. For instance, a recent report by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) highlighted the role of sustainable education in achieving the Sustainable Development Goals (SDGs) and promoting inclusive development. Sustainable education is a powerful tool for promoting national development and creating a more sustainable future for generations to come.

The Role of Mathematics in sustainable Development

Mathematics has no doubt contributed immensely in all facets of human development economically, socially, scientifically and technologically. For the fact that creativity skills are needed for innovative and meaningful development in any society, Mathematics becomes an enhancer for sustainable development due to its influence in the learner to inculcate critical thinking and logical reasoning that will lead to the desired positive changes. According to Anyagh, Agbo-Egwu, & Sabastine (2018), Mathematics helps individuals in the development of analytical and critical minds thus, sustaining consistency in the individual to face and conquer day-to-day challenges of life. Agreeing to this assertion, Nwamaka (2019) acclaimed that, knowledge of mathematical concepts builds entrepreneurial skills necessary for development in humans. Mathematics is a veritable tool needed for sustainable education and national development, essential for self-reliance, self-sufficiency, and self-actualization due to its creativity skill, innovative ideas, and its effectiveness in problem solving and in making concise decisions. They concluded that the teaching and learning of Mathematics is that the knowledge and understanding gained be applied in innovative ventures that will foster societal growth and national development in all spheres (Olukemi & Gbenga, 2016; Blessing & Peter, 2019).

The usefulness of Mathematics in Sustainable Development

As the bedrock of science and technology that all sciences anchor upon, Mathematics has become the springboard for sustainable education and national development Charles-Ogan, (2014). In today's' world, Mathematics has made massive impacts though its influences may appear hidden or not directly seen, yet, has shaped the society globally in diverse ways. Mathematical concepts and ideas have revolutionized the electronics world that gives so much comfort to man. The world has been transformed into a global village technologically via ICT (information and communication technology). These advances in science and technology are made possible by the numerous developments in mathematics. The knowledge of Mathematics has helped Scientists in weather predictions, in detecting environmental hazards and proffering solutions, and in projecting the outcome of electrons and averting the dangers inherent in them. In this 21st century, Mathematics is indeed a veritable tool for sustainable education and national development. Added to the above, Mathematics has found usefulness in the following areas: it helps the government in determining the population of their countries; lawyers use logical reasoning borrowed from Mathematics in arguing cases in the law courts;

Engineering (whether electrical, civil, mechanical, or metallurgical and material), are making waves in the society due to the knowledge of Calculus. Mathematics provides the models, symbols, and logic that are needed in processing mechanization. Knowledge of Mathematics enables the farmer measure farm lands and to estimate the quantities of seeds that can be planted on a given parcel of land and the harvest that can be gotten from that land. Nchouji, Garba, & Mukhtar (2018), affirmed that a sound knowledge of Mathematics is a necessity in addressing the challenges of hunger, economic transformation and globalization, as well as eradicating poverty and unemployment. In medicine Mathematics is used for analyzing data such as in thermometer readings on the causes of illness and how drugs can be administered. Mathematics also finds applications in the business sectors as business personnel with sound knowledge of mathematics manage their businesses more efficiently than their counterparts who are not grounded in the subject. Mathematics teachers therefore have a big task before them to inculcate mathematical skills needed for the desired transformation that will cushion the rate of overdependence on white collar jobs leading to unemployment in the nation. Suffice to say that the level of Mathematical knowledge an individual needs in a function of his or her profession and the set goals to be achieved. For example, the road side mechanics, carpenters, bricklayers, and plumbers, the hairdresser, and the fashion designer in the discharge of their duties, applies Mathematics skills relevant to their fields technically. Indeed, Mathematics education is needed by all a sundry for self and national development and sustainability.

Challenges of Mathematics Education towards Sustainable Development

Mathematics education plays a critical role in advancing sustainable development by equipping individuals with essential problem-solving skills and analytical thinking abilities. However, there are several challenges that need to be addressed to enhance the effectiveness of Mathematics education in promoting sustainable development. One major challenge is the lack of Mathematics teachers with digital skills. Many schools face a shortage of teachers with strong Mathematics backgrounds, resulting in subpart instruction and limited access to quality education. Curriculum is the totality of experiences designed to achieve learning in the educational system. There would be need therefore to update the Mathematics curriculum to include relevant real-world applications that highlight the connections between Mathematics and sustainable development. Integrating concepts such as environmental conservation, resource management, and climate change into the curriculum can help students understand the practical implications of Mathematics in addressing global challenges (UNESCO, 2017).

Another challenge is the prevalence of math anxiety among students, which can hinder their ability to engage with mathematical concepts and apply them in real-world scenarios. Addressing math anxiety requires a multifaceted approach that includes teacher training, the implementation of student support programs, and the promotion of a positive attitude towards Mathematics.

Furthermore, the lack of access to technology and resources poses a significant barrier to effective Mathematics education in many educational settings. Without access to tools such as computers, calculators, and interactive learning platforms, students may struggle to grasp complex mathematical concepts and develop essential skills for sustainable development. According to Momani, (2023) when technological tools are applied in teaching and learning Mathematics, students are motivated to engage in the learning process, as teaching becomes hand-on activities, and math anxieties are minimized. Hence, policymakers, educators, and stakeholders must work together to prioritize Mathematics education as a key interface of sustainable development.

Conclusion

The paper investigated the influence of Mathematics education on students' creativity skills for sustainable development. Mathematics education, of a truth is an indispensable tool needed in all spheres of human endeavor for sustainable development. Since sustainable development is rooted in creativity, innovative ideas and problem solving skills, and in making good decisions, the government should invest in teacher training programs, update curriculum standards, and provide equitable access to resources that will enhance Mathematics education for sustainable development, thereby finding a lasting solution to all the problems and challenges facing the teaching of Mathematics.

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