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The Interconnection between Mathematics Education and Entrepreneurship Education: Implications for Sustainable Education

[1]Saba Ibrahim Kabir; [2]Sulayman Dauda Gidado (PhD); [3]Oduola Samsom Oluyemi
[1,3]Department of Mathematics, School of Sciences, FCT College of Education, Zuba–Abuja, Nigeria
[2]Department of Business Education,, FCT College of Education, Zuba-Abuja, Nigeria
kabirbuzhi28@gmail.com, 08037476428

Abstract

This study reviewed literature on the interconnection between mathematics and entrepreneurship education and its implication to sustainable education. The study explained the concepts of mathematics education, entrepreneurship education, sustainable development and sustainable education. The study discussed the benefits of the nexus between mathematics and entrepreneurship education which are the development of feasibility study, provision of accounting information, business forecasting, inventory management, price determination and curriculum enrichment. It also revealed that the implications of the interconnection of the two disciplines to sustainable education are; realization of sustainable development goal 4 (quality education), stimulation of innovation, enhancement of student-centered learning, emphasis on experiential learning and acquisition of problem solving skills. The study concluded that existing research on mathematics and entrepreneurship education provides a background for understanding the current trends, practices, and challenges in the fields, their integration could address the challenges, make learning more relevant, engaging, and applicable to real-world contexts and bring about sustainable development in the society. The study recommended that entrepreneurial activities should be integrated into mathematics curriculum, acquisition of mathematical skills should be emphasized in the teaching of entrepreneurship, workshops and seminars should be regularly organized for mathematics and entrepreneurship educators and there should be mechanism for continuous evaluation and improvement of the integrated curriculum.

Keywords: Interconnection, Mathematics Education, Entrepreneurship Education, Sustainable Development and Sustainable Education

1.0 Introduction

Education is a systematic way of passing information from one person to another. This implies that it is a planned and valuable activity which is a corner-stone and life wire that triggers development in human societies through creation of awareness, and making it possible for people to acquire necessary skills, knowledge and competencies that will make them to compete favourably with others, be fit to live as responsible members of the society and also be efficient and effective in resource utilization thereby reducing inequality and poverty in the society and improve the quality of life of people. Education also paves way for social and political transformation, technological breakthrough and

industrialization. To achieve these goals and objectives of education, different academic programmes among which is Mathematics education are being taught and learnt in schools across the globe. According to Momoh and Yusuf (2015), Mathematics is among the strongest and adaptable mental tools developed by man for their own use. Furthermore, a deduction from the authors showed that Mathematics education is an aspect of education that is capable of making an individual to acquire skills, knowledge, aptitude, abilities and attitude that could make them to be functional and productive for the overall development of the nation. Deductions from Momozoku, et.al (2022) also showed that Mathematics predates western education in Nigeria because people take stock of farming and trading activities. Western education however led to formalization of the discipline with organized curriculum and it is a core subject that is offered at all levels of education. The 2020 edition of the National Commission for Colleges for Education Minimum Standards for Nigeria Certificate in Education (NCE) programmes in vocational and technical education also revealed that business education students study business mathematics and business statistics due to their entrepreneurship attributes.

Entrepreneurship looks at the ability of people to be smart in taking advantage of opportunities before they are discovered by others and transforming ideas into actions by being innovative, initiative, risk takers, planners and managers of projects with the aim of attaining predetermined objective(s) (Eya, 2015). This implies that entrepreneurship has to do with identification of business opportunities and setting up business venture in order to make profit. Based on a deduction from Eya (2015), Entrepreneurship education is conceived as an education whose primary aim is to instill the spirit of identifying business opportunities and setting up businesses in the learner through equipping them with entrepreneurial skills. These skills will enable them to identify business opportunities where others are seeing chaos and have courage for setting up an organization in line with the opportunity. They will also make them to be able to navigate the business world through proper management of the risks that are associated with business in order to make profit.

Entrepreneurship education is an old discipline in Nigeria as people learn trades through apprenticeship in the traditional Nigerian societies. Entrepreneurship education is however popularized by the desire of the government to eliminate the problem of unemployment and challenges such as banditry and armed robbery. This aligns with the vision of Sustainable Development Goals (SDGs) 2030 and as explained by Olujuwon and Udofia (2023), Sustainable Development Goals (SDGs) are also known as Millennium Development goals (MDGs).

There is a connection between Mathematics Education and Entrepreneurship Education. This was supported by Momoh and Yusuf (2015) who stated that Mathematics encroaches in to all aspects of human life. In the same vein, Osuo-Siseken (2017) reported that Mathematics permeates every aspect of human endeavour to the extent that anyone that understands it will certainly master other school subjects. Olom (2019) also stated that Mathematics was developed by man because of man's desire to solve domestic and economic problem such as buying and selling. Furthermore, Attahiru, et.al (2021) posited that the areas that make up the field of Mathematics were necessitated by the need for calculations in business and trade. In addition to this, Sodangi and Adamu (2023)

were of the opinion that Mathematics is a subject of utility and it is a basic activity that forms part of all the languages we speak today. The interconnection between Mathematics education and Etrepreneurship education holds the potential to significantly impact both individual and societal development. This study therefore aims at bringing the nexus between these two critical fields to the fore and also highlights the implications of this effort to sustainable education.

2.0 Literature Review

2.1 Conceptual Underpinning

2.1.1 Mathematics Education

Mathematics education has long been recognized as a cornerstone of academic curricula worldwide. It is essential for the development of critical thinking, problem-solving skills, and a foundation for STEM (Science, Technology, Engineering, and Mathematics) careers. According to Attahiru, et.al (2021), Mathematics is the study of topics relating to quantity, structure, shape and change which leads to the sub division of the discipline into algebra, geometry and analysis. To Idu in Sodangi and Adamu (2023), the objectives of teaching mathematics at all the levels of education are to foster originality, creativity and curiosity in the learner, enable them to acquire manipulative skills, emphasis wide application of Mathematics in all fields and make the learners to develop positive mental attitude toward Mathematics. Based on these, Mathematics is considered fundamental not only for personal intellectual development, but also for national economic growth. It fosters logical reasoning, analytical thinking, and problem-solving skills which are applicable in various real-life situations and professional fields (National Research Council, 2013). In addition, it could be deduced from Adebiyi (2020) that Mathematics education is a fertile ground for science and technology to drive national growth and development.

2.1.2 Entrepreneurship Education

Entrepreneurship education is designed to address the challenges of idleness among youths due inability to engage in economic activities. In the opinion of Eya (2015), Entrepreneurship education is an education that does not make the minds of its recipients to be idle, because it equips them with entrepreneurial skills and develops the spirit of entrepreneurship in the recipients. It is in line with this that Uzo-Okonkwo and Okafor (2021) stated that it is also called enterprise education. As deduced from these authors, entrepreneurship education is a type of education which is crafted to change the attitude and orientation of the learners by equipping them with skills and knowledge that will make them fit to manage their personal businesses or those of others successfully due to the fact that it motivates and gives them confidence for creativity and innovativeness for self-reliance, wealth creation and business management.

2.1.3 Sustainable Development and Sustainable Education

Sustainable development has to do with planning for positive improvement in socio-economic, cultural, political and environmental lives of a nation for the benefits of the present and future generations (Machar, et.al, 2023). This implies that sustainable development takes cognizance of the present and future generations and does not

compromise the benefits of one for the other. Olujuwon and Udofia (2023) also stated that it is a new approach to economic and social activities in both rich and poor societies which is compatible with environmental preservation. They also pointed out that strategies for ending hunger and poverty, providing healthy life, enhancing access to clean water and sanitary facilities, utilizing sources of renewable energy and encouragement of inclusive education and good work are the ways through which sustainable development can be achieved. In the case of sustainable education, it is an education that enhances a balanced national development with focuses on human needs as well as economic and social development (Alam, 2023). This implies it is an approach to learning which equips the learners with skills, knowledge and value that are needed for creating sustainable future through giving priority to the wellbeing of the environment, individuals and communities. Its key principles are interconnectedness, holistic learning, critical thinking, systems thinking, community engagement, cultural relevance and emphasis on sustainability.

2.2 Nexus between Mathematics Education and Entrepreneurship Education

Mathematics is applicable to all aspects of human endeavour and its emergence as a discipline was necessitated by man's efforts towards solving domestic and economic problems and the need for calculations in the business world. The following are some of the benefits to be derived from the interconnection between Mathematics education and Entrepreneurship education:

2.2.1 Development of Feasibility Study

To start a new or expand an existing business, quantitative data are needed for decision making. This implies that mathematics is used in collecting data that are required in developing a sound feasibility study. A deduction from Oluwafemi and Adeagbo (2017) showed that feasibility study is used in managerial decision in relation to whether to accept, modify or reject a business proposal. It is thus, a pre- investment assessment of the factors that surround a proposed investment plan by pointing out clearly the risks that are involved in it. This shows that figures are used among other things to determine the volume of manpower, raw materials and money required for the business. The result is therefore used in taking decision in relation to viability of a venture so as to know whether it is worthy of being pursued.

2.2.2 Provision of Accounting Information

Accounting is an important activity for survival and sustainability in entrepreneurship. According to Gidado and Babakura (2019), it is the day to day recording, classification, analysis and interpretation of financial data of a business that are used in the determination of its financial position at any given period of time. Sodangi and Adamu (2023) reported that mathematical principles such as numeracy, geometry and logical relationships are utilized in study and practice of accounting. The authors also reported that formulae and mathematical relations were developed for inventory turnover ratio, profitability ratio, debtor turnover ratios, and debt-equity ratio. Mathematics skills are also used in profit determination and preparation of balance sheet which presents the

financial status of an entity thereby making the stakeholders and users of accounting information to know whether the business is healthy or already manifesting symptoms of failure.

2.2.3 Business Forecasting

Entrepreneurs forecast business trends using statistical data. According to Sodangi and Adamu (2023), businessmen use statistics (an element of mathematics) to determine change in demand and fluctuations in the market. It is also used to determine sales and future returns as well as evaluation of risks associated with a venture. Furthermore, entrepreneurs utilize statistics in analyzing the effects of population structure, consumer income, tastes, habits and preferences and pricing policies of the competitors as well as their likely effects on their investments.

2.2.4 Inventory Management

In the pre-modern society, mathematics is used for taking stock in farming and trading activities. (Momozoku, et.al, 2022). A critical look at this revealed that mathematics is used for inventory management in both the past and present societies. A deduction from Osimabale and Gidado (2015) revealed that inventory management plays important role in physical distribution and it helps an organization in avoiding under stocking and overstocking. This implies that integration of mathematics into entrepreneurship will make businessmen to be rationale in stock keeping for the purpose of retaining and satisfying the needs of their customers and avoid losses that are associated with overstocking.

2.2.5 Price Determination

Some strategies for fixing prices for goods and services are quantitatively determined using mathematical relations. Notably among these are; the cost-plus and return on investment pricing policies. The former is derived by adding a margin to the cost of production or purchase, while the latter is arrived at using the projected profit for a given accounting period. This is a clear indication that knowledge of Mathematics can be used in determining the appropriate price to be fixed for a product.

2.2.6 Curriculum Enrichment

The nexus between Mathematics education and Entrepreneurship education also leads to curriculum enrichment. In line with this, it is obvious that some business concepts are mathematically expressed and taught in Mathematics. For instance, simple interest, compound interest, calculation of cost and sales prices, profit and loss are topics that are taught in General Mathematics. In the same vein, topics in Mathematics such as matrices, determinants, differential calculus, simultaneous and linear equations are taught in business and entrepreneurship education in order to enable the learners to acquire skills for forecasting and taking business decisions.

2.3 Implications of the Connection between Mathematics Education and Entrepreneurship Education to Sustainable Education

Integration of Mathematics education and Entrepreneurship education is paradigm shift which is expected to have positive impact on education. The following are the implications of this nexus to sustainable education:

2.3.1 Realization of Sustainable Development Goal 4 (Quality Education)

The connection between Mathematics education and Entrepreneurship education will contribute to the attainment of SDG 4 (quality education) by promoting an inclusive and equitable quality education that fosters lifelong and learning opportunities for all. This approach can help bridge the gap between theoretical knowledge and practical application, thereby, preparing students for future challenges and opportunities.

2.3.2 Stimulation of Innovation

The integration of Mathematics and Entrepreneurship education can contribute to sustainable development by fostering innovation, promoting responsible business practices, and supporting the development of sustainable industries (Hall, et.al, 2010). This implies that it will prepare the students to become innovative in proffering sustainable solutions to complex global challenges, such as climate change, resource management, and social inequality.

2.3.3 Enhancement of Student-Centered Learning

Integration of mathematics and entrepreneurship education encourages student-centered learning. Modern educational practices focus on active engagement and personalized instruction. This approach is supported by constructivist theories. According to Ekpenyong and Edokpolor (2016), constructivism advocates that learners should be made to construct knowledge through experiences and interactions. This implies that students will have the opportunity of using participation and experience for acquiring useful skills that will push the frontiers of knowledge forward and enhance sustainable development.

2.3.4 Emphasis on Experiential Learning

A dominant trend in entrepreneurship education is the emphasis on experiential learning. Hands-on experiences, such as business simulations, startup incubators, and real-world

projects are integrated into effective entrepreneurship education (Neck & Greene, 2011). Integration of mathematics and entrepreneurship education will therefore allow students to apply theoretical knowledge in practical settings and enhance their learning and confidence which will lead to sustainable education.

2.3.5 Acquisition of Problem Solving Skills

Integration of mathematics and entrepreneurship education makes students to acquire problem solving skills. According to Sodangi and Adamu (2023), problem solving builds on students' prior knowledge. They are therefore of the view that development of ingenuity in students, heuristic thinking and mathematical creativity ultimately makes students to be skillful. This implies that problem solving has the potential for making the

learners to be independent in thinking and develop concepts and judgement that would lead to cognitive development. The end product of this process is the realization of sustainable education that would all things being equal lead to sustainable development in the society.

5.0 Conclusion and Recommendations

This section presents the conclusion and recommendations of the study based on the findings.

5.1 Conclusion

Mathematics and entrepreneurship education are distinct but interrelated disciplines which are required for progress in human societies. This paper established that the nexus between the two useful disciplines can improve business practice and enrich the curriculums of the disciplines. Furthermore, the implications of the interconnection to sustainable education include; enhancement of quality education, stimulation of innovation, encouragement of student-centred learning, emphasis on experiential learning and acquisition of problem solving skills. The implications of these are that existing research on mathematics and entrepreneurship education provides a robust foundation for understanding the current trends, practices, and challenges in the two fields and their integration have the potentials for addressing the challenges by making learning more relevant, engaging, and applicable to real-world contexts which will ultimately lead to sustainable development.

Recommendations

Based on what have been presented so far as well as the conclusion drawn therefrom, the following recommendations are advanced:

i. Mathematics curriculum should be developed to integrate entrepreneurial activities.
ii. There should be emphasis on the acquisition of Mathematics skills in the teaching of entrepreneurship in educational institutions.
iii. Workshops and seminars should be organized regularly for mathematics and entrepreneurship educators to enhance their content knowledge, pedagogical strategies and collaboration among them.
iv. Mechanisms for continuous evaluation and improvement of the integrated curriculum should be established. This can be achieved through collecting feedback from students, teachers, and other stakeholders in order to identify areas that need modification or improvement.

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