# THE PERCEPTION OF MATHEMATICS TEACHERS ON SUSTAINABLE DEVELOPMENT GOALS: IMPLICATION FOR AN ECONOMY BEYOND OIL

**By**

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## Abstract

*The study was on the perception of mathematics teachers on sustainable development goals. A survey research design was adopted for the study. The population of the study was mathematics teachers in 619 secondary schools in plateau state comprising of 317private secondary schools and 302 public secondary schools. A random sampling technique was used to obtain 81 mathematics teachers from 81 secondary schools during the congress meetings of the Mathematical Association of Nigeria, Plateau State chapter. The sample consisted of 37 teachers from private school and 44 teachers from public school. An instrument titled: Mathematics Teachers Perception of Sustainable Development Goals(MTPSDGs) was used for data collection. MTPSDGs had a reliability of 0.71 based on Cronbach's Reliability Coefficient. Data collected was analysed using mean, standard deviation, t-test and chi-square. The findings of the study showed that the perception of mathematics teachers on achieving Sustainable Development Goals(SDGs) through mathematics was significantly high.And there was no significant difference between the perceptions of public secondary school mathematics teachers and that of their private secondary school counterparts on achieving SDGs through mathematics. Therefore, it was recommended that mathematics teachers should incorporate SDGs in the teaching-learning process by given exercises that could enhance the realisation of the of SDGs.*

***Keywords**: Mathematics, Sustainable Development Goals.*

## Introduction

Naturally, manmakes choices but sometimes those choices made by man threaten his existence on earth. This calls for a concerted effort to avoid man's extinction on earth by adapting measures that could correct man's inhumanity to man and nature. A country like Nigeria that wantsto harness both human and material resources to the fullest need to adapt sustainable development measures. There is no doubt that a sustainably developed country ensures that its citizens acquire both physical and intellectual skills which enable them to create job for themselves and live a meaningful life (Nwigboji& Egbe,2017). These depend on improving the quality of life for all without undermining the sustainability of natural environment for the needs of the future generations(Ugwuda, 2014; Kurumeh&Igyu, 2015).

The waymathematics concepts are developed and taught will go a long way in helping students to improve on their understanding of both concepts and applications in life. Mathematics teachers are supposed to develop and present mathematics contents in a way that students will thinklogically and critically in order to see relationships between mathematics and their environment. There is no uncertaintythat when students understand their natural environment they can engage in exploits that could ensure its sustainability. So, through the instrumentality of mathematics, a country like Nigeria that desires self-reliance and sustainability of its citizens in the face of current trends of unsustainable economic policies, should attune to the 17 sustainable Development Goals(SDGs) adopted by the United Nations General Assembly on September 25, 2015, for sustainable economic policies(Newen, 2014; World Bank, 2016).

**Poverty (**End poverty in all its forms everywhere)is the 1st SDG.Poverty is a situation where the level of individual welfare is inadequate and socially unacceptable. It could be a lack of income or resources, a lack of coping capacity, a lack of basic human capabilities, a lack of defense or in extreme cases a lack of all these (Ugboduma&Alio, 2014; Dabo&Gukas, 2016; Orkar, 2016).Poverty exerts its influence on the teaching and learning of mathematics and it transcends the boundaries of gender, school-type and family-type (Guwam, 2017a). Nevertheless, effective teaching of mathematics contributes towards poverty alleviation byproviding sound knowledge for critical analysis and intellectual considerations of issues and events. These help one toadvise government on budgeting and financial allocation, to sustain national development and stability for poverty reduction (Chado&Bala, 2014; Onakpa, 2016).

**Hunger (**End hunger, achieve food security and improved nutrition and promote sustainable agriculture) is the 2nd SDG. Nigeria attainment of food security to end hunger can only be through good agricultural practices. Agriculture is essential for nutritional development for sustainable development of any nation. Nigeria as an agrarian country needs mathematics because mathematics helpsin soil analysis to ensure high yield. In the farming processes, farmers used the knowledge of mathematics in keeping their farm diary, spacing of crops, estimate and measure of quantity of crops, inputs and outputs, records of livestock and feeds(Alio&Nnamani, 2015; Orkar, 2016).

**Good Health and Wellbeing**(Ensure healthy lives and promote well-being for all at all ages) is the 3rd SDG.There is a common saying that heath is wealth. This is because heathy living of a nation's citizen is a fundamental condition for a prosperous economy.Mathematical tools are being applied in obtaining quantity and quality measures in the medication of drugs to patients, modelling of healing of wounds, pharmacokinetics, drug regimens and healing of wounds, and genetics(Anyor&Adiku, 2013; Okwuoza&Azuka, 2015; Usman &Ojo, 2015).

**Quality Education**(Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all) is the fourth SDG.According to the United Nations Education Scientific and Cultural Organisation [UNESCO](2017),education is a top priority because it is a basic human right, and the foundation on which to build peace and drive sustainable development. The knowledge of mathematics helps one to acquire basic functional skills for self-reliance, andhas the economic benefits of better preparing one for numeracy skills demands of modern industrial work place (Hassan &Garba, 2014; Alio&Anaeche, 2016).

**Gender Equality**(Achieve gender equality and empower all women and girls) is the fifth SDG.Gender indicates whether one is a male or female. According to "Sex" (2009), it is a physical and behavioural difference that distinguishes individual organism according to their functions in the reproduction processes.Melamed (2011) notes that the evidence from recent trends shows that even if countries start from a position of relative equality, without active attention from governments,inequality will exist and rise. Non-Governmental Organisations like Amnesty International (2016) emphasises end to all forms of violence against women like trafficking and sexual exploitation.In order to share opportunities between gender, ratios and percentage can beused togeneratedemographic data for making appointments and employment of workers among others(Uwaigiahano&Okwuoza, 2015; Orkar, 2016).

**Clean Water and Sanitation**(Ensure availability and sustainable management of water and sanitation for all) is the sixth SDG. This goal focuses on Water, Sanitation, and Hygiene (WASH) through proper solid waste disposal, sewage disposal, and cleanliness during food processing and preparation ("Sanitation",2009; UNICEF, 2014). There are improved drinking water sources:piped water into dwelling, plot or yard, public tap/standpipe, tube well/borehole, protected dug well, protected spring, rain water.And unimproved drinking water sources: unprotected dug well, unprotected spring, small cart with tank/drum, tanker truck, surface water, and bottle water (UNICEF, 2009).Mathematics helps an individual tounderstand the environment and to give accurate account of the physical phenomena (Ichipi&Panya, 2016).

**Affordable and Clean Energy**(Ensure access to affordable, reliable, sustainable and clean energy for all)is the 7th SDG.Energy is the capacity of a matter to perform work as a result of its motion (kinetic) or its position in relation to force acting on it(potential). It exists in different forms, including mechanical, thermal, chemical, electrical, radiant and atomic ("Energy.", 2009). Unclean energy emits a lot of carbon into the atmosphere which depletes the ozone layer leading to environmental hazards like rising temperature, flood and desert encroachment. During the 1970s,the world began a painful adjustment to the vulnerability of energy supplies (Yergin, 2009). In thediscovery processes of energy like exploration, estimation of reserves, pricing, and deciding of exportation quota, as well as detecting of environmental hazards and clean forms of energy, mathematical indices play a crucial role.

**Employment and Economic Growth**(Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all)is the 8th SDG.Economic growth is related to the ability of a society to increase both human and physical capital, and improve its technology.But,due to differences in the organisation of production, some countries areunable to use their resources efficiently (Acemoglu& Robinson, 2008). Economy of any nation depends on deliberate planning and meticulous execution of plans which are dependent on critical reasoning (Guwam, 17b). Also, some mental mathematical principles are essential intrades like sewing, mechanical engineering, vulcanizing, brick-laying,and carpenteringwhich impacton the economy(Nkwocha, 2016).

**Industrial Innovation and Infrastructure**(Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation) is the 9th SDG. Industrial innovation means bringing new ideas or product in the area of industry. This leads to expansion of industry which eventually generate infrastructure or basic facilities where it is sited. Creativity is the art of conceiving something original while innovation is the implementation of something that is new. Theyare enhanced bythe mathematics principles of clarity,precision, and critical thinking (Kurumeh&Dogo, 2015;Alio&Nnamani, 2015; Uwaigiahano&Okwuoza, 2015).

**Reducing Inequality**(Reduce inequality within and among countries) is the 10th SDGs.Equality of opportunity exists when life outcomes depend only on factors for which persons can be considered responsible, and not on disadvantageous attributes outside of their control like gender, ethnicity, and family background ("Inequality", 2015). According to Melamed (2011) 'Inequality' is not one thing, but is made up of multiple and overlapping inequalities in such things as gender, income, wealth, educational and health outcomes, social status and political power, geography, religion, and race. Organisation for Economic Co-operation and Development (OECD) opines that assessments of economic performance should not focus solely on overall income growth, but also take into accountincome distribution(OECD, 2012).

This can better be handled by mathematical toolslike ratios and percentages useful in planning strategies to reduce inequality (Abubakar, Charles-Ogan& Albert, 2014).

**Sustainable Cities and Communities** (Make cities and human settlements inclusive, safe, resilient and sustainable)is the 11th SDG. Achieving environmental sustainability means urban consumption must match or be below what the natural environment like forests, soil and oceans can provide, and the resulting pollutants must not overwhelm the environment's ability to provide resources to members of the ecosystem ("Science for Environment", 2015).One needs to mind the energy, waterand materialsthat go into the building during its construction and use because a building does not exist in isolation but needs constant inputs from the exterior and generates constant waste to be assimilated by the exterior (Cushman-Roison, 2015). Developing sustainable cities and communities require planning. And we need statistical data for proper town planning otherwise there will be congestion and absence of recycling facilities.

**Responsible Consumption and Production**(Ensure sustainable consumption and production patterns) is the 12th SDG.This focuses on reducing environmental pressure caused by excessive consumption.Sustainable consumption and production are derived from recognition of the fact that the lifestyles of people in developed countries are unattainable for their own citizens without excessive over-exploitation of environmental resources (Lucci,Khan& Stuart, 2015). In the view of United Nations (2015),critical thinkingis needed to develop a good understanding of the multiple causes and potential solutions to irresponsible and unsustainable consumption and production patterns. This depends on mathematicaltechnique such as accurate statistics which enables us tominimise cost and maximise profit, calculate our wages and adjust our expenditure towards sustainable economic living (Onakpa, 2016; Nwigboji&Egbe, 2017).

**Climate Action** (Take urgent action to combat climate change and its impacts) is the 13th SDG.Climate action(n.d.). This targets climate change which threatens the way we live and the future of our planet. By addressing climate change, we can build a sustainable world for everyone. Mathematics facilitates scientific and technological development which improve the ability to predict weather, effect of environment hazards, project the outcome of electrons, and adopt ways of mitigating the negative effects of climate change (Ndibe, Bello & Usman, 2016).

**Life Below Water**(Conserve and sustainably use the oceans, seas and marine resources for sustainable development) is the 14th SDG. This refers to conservation and sustainable use of the oceans, seas and marine resources as well ascoastal zones. Oceans cover more than 70% of the planet's surface and play a crucial role in planetary resilience and the provision of vital ecosystem services (Schmidt, Neumann,Waweru, Durussel,Unger &Visbeck, n.d.). Contamination of coastal zones or seafood with pollutants can cause health problems. So,knowledge and capacity building, and training and awareness programmes on ocean and sea services will positively reduce pollution,enhance sustainable use of the oceans, seas and marine resources. For people to be properly informed of ocean resources, statistics on level of pollution, endangered species of aquatic animals and rise in sea level among others are required.Mathematics plays a crucial role in providing the required tools for easy understanding of these.

**Life on Land**(Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss) is the 15th SDGs. Land is the ground beneath our feet and everything

that lives in it; it is forests and wetlands, grasslands and farmlands, and it is our home and our heritage (International Union for Conservation of Nature and Natural Resources [IUCN], 2016). Forests cover nearly 31 per cent of our planet's land area. And about 75 per cent of the world's poor are affected directly by land degradation which affects the forest; beautiful landscapes, rich fauna and flora, and natural heritage sites(Karschat&Kühhas, 2015;Life on land, n.d.).The estimates of the costsfor achieving sustainable forest management involve figures obtainable from mathematics.

**Peace, Justice and Strong Institution**(Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels) is the 16th SDG. Porter (2015) explains that peace, justice and reconciliation are bound intricately. The absence of these pause a challenge of living in failed or failing state where the government does not govern effectively. Hodgson (2006) opines that the existence of rules constitutes a constraint that create choices and actions that otherwise would not exist. This promotes peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable institutions ("Sustainable Development", n.d.).There is hardly any meaningful justice and accountability in an institution without the usage of mathematical tools.

**Partnership for Global Development** (Strengthen the means of implementation and revitalize the global partnership for sustainable development) is the 17th SDG.In September 2000, according to Mundo (2004), political leaders from 189 countries, attended the Millennium Summit at UN headquarters, where developed countries pledged to improve development to less advanced countries in both quantitative and qualitative way. In addition, policies in other areas such as trade regulations and debt management are of equal or even greater significance for the future of developing countries (Lucci, Khan & Stuart, 2015).Mathematics allows one to model relationships with enough precision to gain insight into how things work and how things may be changed in the future (Anjil, 2016).

**Statement of the problem**

Mathematics teachers need to understand its applications and how ideas are integrated across subject matters. This will enable them to see mathematics possibilities in students' statement or written work (Ferrini-Mundy &Fidell, 2010). In the course of teaching, mathematics teachers are expected to presented mathematics contents in such a way that the subject becomes real, concrete, attractive, interesting, captivating, motivating and relevant to life (Azuka, 2015). SDGs were set to make man's life on earth meaningful and sustainable. It is expected that Nigeria would achieve SDGs by 2030 if she keyed into the policy. Since education is the framework for achieving any goal, teachers are expected to key into the policy by incorporating SDGs in the teaching-learning process. But, many mathematics teachers know little about what Education for Sustainable Development means (Allfey, 2001). Is this still the case today?

**Methodology**

A descriptive survey research design was used to carry out the study. The population of the study was mathematics teachers in 619 secondary schools in Plateau State, comprising of 317 private secondary schools and 302 public secondary schools. A sample of 81 mathematics teachers was randomly selected from 81 secondary schools during the congress meetings of the Mathematical Association of Nigeria, Plateau State chapter. It was made of 44 mathematics teachers of public secondary school and 37 mathematics teachers of private

secondary school. The instrument used for data collection was a structured questionnaire titled: Mathematics Teachers Perception of Sustainable Development Goals(MTPSDGs). MTPSDGs was administered to 20 participants who did not constitute the sample, and Cronbach's Reliability Coefficient of 0.71 was obtained. MTPSDGs was made of 17 items and had 4-point rating scale of Very High (VH), High (H), Low (L) and Very Low (VL) representing 4, 3, 2 and 1 respectively. During the analysis, items with a mean equal to or greater than 2.50 were accepted while items with mean less than 2.50 were rejected. Data collected was analysed using mean, standard deviation, t-test and chi-square in Statistical Package of Social Sciences (SPSS) 20.

**Research Questions**

The following research questions were answered:

1. What are mathematics teachers' perception on achieving SDGs through mathematics?
2. Will there be any difference between mathematics teachers' perception on achieving SDGs through mathematics in terms of school-type?

**Hypotheses**

The following null hypotheses were tested:

**$H_{01}$**: The perception of mathematics teachers on achieving SDGs through mathematics is not significantly high.

**$H_{02}$**:There is no significant difference between the perception of public school mathematics teachers and that of their private school counterparts on achieving SDGsthrough. mathematics.

**Results**

**Table 1:**Showing Teachers' Perception on Achieving SDGs through Mathematics Education

| S/N | Statement | VH | H | L | VL | Mean | Stdev |
|---|---|---|---|---|---|---|---|
| 1 | It helps in planning to reduce poverty | 36 | 39 | 6 | 0 | 3.3704 | 0.6214 |
| 2 | It helps in planning to reduce hunger | 14 | 51 | 15 | 1 | 2.9630 | 0.6412 |
| 3 | It helps in planning for good healthcare services | 33 | 27 | 18 | 3 | 3.1111 | 0.8803 |
| 4 | It helps in planning for quality education | 56 | 23 | 2 | 0 | 3.6667 | 0.5244 |
| 5 | It helps in planning for clean water and sanitation | 12 | 39 | 22 | 8 | 2.6790 | 0.8489 |
| 6 | It helps in planning for affordable and clean energy | 14 | 45 | 16 | 6 | 2.8272 | 0.8030 |
| 7 | It helps in planning infrastructural development | 31 | 34 | 13 | 3 | 3.1481 | 0.8233 |
| 8 | It helps in planning communities and cities | 28 | 35 | 14 | 4 | 3.0741 | 0.8482 |
| 9 | It helps in planning for responsible consumption | 28 | 32 | 18 | 3 | 3.0494 | 0.8500 |
| 10 | It facilitates planning for rational production | 34 | 32 | 14 | 1 | 3.2222 | 0.7746 |
| 11 | It facilitates planning for good relationship and partnership | 25 | 48 | 7 | 1 | 3.1975 | 0.6407 |
| 12 | It helps in planning for employment and economic growth | 42 | 32 | 6 | 1 | 3.4198 | 0.6867 |
| 13 | It helps in planning to create strong institution | 37 | 35 | 8 | 1 | 3.3333 | 0.7071 |
| 14 | It helps in planning to facilitate reduction in inequality | 20 | 33 | 25 | 3 | 2.8642 | 0.8330 |
| 15 | It helps in planning to facilitate industrial innovation | 27 | 41 | 9 | 4 | 3.1235 | 0.7966 |
| 16 | It helps in planning to sustain life on land and below water | 20 | 29 | 21 | 11 | 2.7160 | 0.9904 |
| 17 | It helps in planning for partnership for global development | 37 | 32 | 11 | 1 | 3.2963 | 0.7491 |
| | **Grand Mean and Standard Deviation** | | | | | **3.1213** | **0.7658** |

Table 1 shows that the mean of each of the items range from 2.6790 to 3.6790which are greater than 2.50 as the grand mean is 3.1213. These means that mathematics teachers' perception on achieving SDGs through mathematics was very high.

**Table 2**: Showing Public and Private Schools Teachers' perceptions on Achieving SDGs through Mathematics.

| S/N | Statement | Public | | Private | |
|---|---|---|---|---|---|
| | | Mean | Stdev | Mean | Stdev |
| 1 | It helps in planning to reduce poverty | 3.3182 | 0.6013 | 3.4324 | 0.6472 |
| 2 | It helps in planning to reduce hunger | 2.9318 | 0.5866 | 3.0000 | 0.7071 |
| 3 | It helps in planning for good healthcare services | 3.1364 | 0.8516 | 3.0811 | 0.9243 |
| 4 | It helps in planning for quality education | 3.6818 | 0.5182 | 3.6486 | 0.5383 |
| 5 | It helps in planning for clean water and sanitation | 2.8182 | 0.8428 | 2.5135 | 0.8374 |
| 6 | It helps in planning for affordable and clean energy | 2.8864 | 0.6893 | 2.7568 | 0.9251 |
| 7 | It helps in planning infrastructural development | 3.1591 | 0.8053 | 3.1351 | 0.8551 |
| 8 | It helps in planning communities and cities | 3.0682 | 0.8733 | 3.0811 | 0.8293 |
| 9 | It helps in planning for responsible consumption | 3.0000 | 0.8892 | 3.1081 | 0.8091 |
| 10 | It facilitates planning for rational production | 3.1818 | 0.7555 | 3.2703 | 0.8045 |
| 11 | It facilitates planning for good relationship and partnership | 3.2273 | 0.6048 | 3.1622 | 0.6877 |
| 12 | It helps in planning for employment and economic growth | 3.3409 | 0.6450 | 3.5135 | 0.7311 |
| 13 | It helps in planning to create strong institution | 3.3636 | 0.6503 | 3.2973 | 0.7769 |
| 14 | It helps in planning to facilitate reduction in inequality | 2.8864 | 0.7840 | 2.8378 | 0.8980 |
| 15 | It helps in planning to facilitate industrial innovation | 3.0682 | 0.8463 | 3.1892 | 0.7393 |
| 16 | It helps in planning to sustain life on land and below water | 2.7273 | 0.9242 | 2.7027 | 1.0766 |
| 17 | It helps in planning for partnership for global development | 3.1364 | 0.7653 | 3.4865 | 0.6921 |
| **Grand Mean and Standard Deviation** | | **3.1136** | **0.7431** | **3.1304** | **0.7929** |

Table 2: Indicates that the grand mean and standard deviation for public school are 3.1136 and 0.7431 respectively. While those of private school are 3.1304 and 0.7929 in the same order. The differences in grand mean and standard deviation are 0.0168 and 0.0498 respectively in favour of private school. This implies that there was no significant difference between the perception of public school mathematics teachers and that of their private school counterparts.

**Table 3**: $X^2$ Frequency Counts on Perception of Mathematics Teachers on Achieving Sustainable Development Goals through mathematics.

| **Responses** | **VH** | **H** | **L** | **VL** | $\mathbf{X^2_{-Cal}}$ | $\mathbf{X^2_{-Crit}}$ | **Decision** |
|---|---|---|---|---|---|---|---|
| **Observed** | 494 | 607 | 225 | 51 | 556.801 | 7.82 | Sig |
| **Expected** | 344.3 | 344.3 | 344.3 | 344.3 | | | |

Table 3shows that calculated $X^2$ is (551.81) which greater than table $X^2$(7.82). Hence, $\mathbf{H_{01}}$is rejected. It implies that the perception of mathematics teachers on achieving SDGs through mathematics was significantly high.

**Table 4**: Showing t-Test of Teachers' Perception of SDGs based on School-Type.

| **School-Type** | **Number** | **Mean** | **Std.Dev** | **Alpha** | **Df** | **t-Cal** | **t-Crit** | **Decision** |
|---|---|---|---|---|---|---|---|---|
| **Private** | 37 | 3.1304 | 0.7929 | 0.05 | 79 | 0.0977 | 2.000 | Not Sig |
| **Public** | 44 | 3.1136 | 0.7431 | | | | | |

Table 4: indicates that $t\text{-}_{Cal}$ (0. 0977) $<t\text{-}_{Crit}$ (2.0000). Therefore, $\mathbf{H_{02}}$is not rejected. It means that there was no significant difference between the perception of public school mathematics teachers and that of their private school counterparts on achieving SDGs through mathematics.

## Discussions

One of the findings of this study is that the perception of mathematics teachers on achieving SDGs through mathematics is significantly high. This concurs with the submissions that mathematics is applied in:proper budgeting and finance to end poverty; the preparation of soil for the purpose of analysis; obtaining quality measures for good health and wellbeing, enhancing ones numeracy demand of modern workplace; generating demographic characteristics and growth rate for equal distribution; understanding the environment through accurate account of phenomenon; mental mathematical principles for sewing, electrical and mechanical engineering among others; development of rational thinking required for creativity and innovation; manipulating members and materials for planning towards responsible consumption; predicting whether to measure effect of environmental hazards for climate action; and acquiring knowledge and skills for individual self-reliant and self-development for partnership in global development(Chado&Bala, 2014; Orkar, 2016; Usman &Ojo, 2015;Alio&Anaeche, 2016; Ichipi&Panya, 2016;Nkwocha, 2016; Uwaigiahang&Ukwuoza, 2015; Abubakar, Charles-Ogan, Albert, 2014; Ndibe, Bello & Usman, 2016; Anjil, 2016). It also reveals that mathematics teachers' perception on achieving SDG through mathematics is not dependent on school-type.

## Conclusion

The researcher investigated mathematics teachers' perception on achieving SDGs through mathematics. It was obvious from the findings of the study that the perception ofmathematics teachers on achieving SDGs through mathematics was very high. And it was revealed that mathematics teachers' perception was not dependent on school-type. Therefore, mathematics teachers should key into incorporating SDGs in the teaching-learning process by given examples and exercises that would enhance the realisation of the SDGs by 2030.

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