Perception of Teachers on the Role of Mathematics in Technological Renaissance of the 21st Century: Implications for Innovations and Productivity

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ABSTRACT

This study explored teachers' perception of the role of mathematics in technological renaissance of the 21st century within the blueprint of descriptive survey research design of an ex-post facto type. 235 senior secondary school teachers selected from 16 public schools in education district three of Lagos State participated in the study. Data were collected through Teachers' perception of the role of mathematics in technological renaissance questionnaire (TPMTRQ with Cronbach's coefficient alpha, =.88 for internal consistency reliability) and analysed using descriptive statistics of percentage, mean, and standard deviation and inferential statistics of an Independent samples t-test. The results showed that teachers recorded low perception of the role of mathematics in technological renaissance of the 21st century irrespective of their gender and discipline of study. It was therefore recommended that national orientation and advocacy programmes should be instituted in schools across the nook and cranny of this country to popularize the teaching and learning of mathematics and its relation to the advancement of technology and national development. More so, strategic agency like the Nigerian Mathematical Centre (NMC) should be grossly funded for it to discharge its corporate responsibilities as poor funding is inimical to poor performance of the agency. In conclusion, implications for innovations and productivity were given.

Keywords: Mathematics; teachers; technology; renaissance; 21st century; perception

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1. INTRODUCTION

In Nigeria, mathematics education is one of the countrywide primacies. This is because year in year out Nigerian students perform abysmally poor in mathematics as implicated by the statistics turned out by the West African Examinations Council (WAEC). 19 years down the 21st century in Nigeria, the legacy of poor performance in mathematics in both internal and public examinations experienced during the 20th century is still ubiquitous in most schools. The recent West African Senior School Certificate Examination (WASSCE) results in mathematics for 2018 released this year for public consumption showed that Nigerian students recorded low proficiency in mathematics. This low mathematical proficiency is a threat to students' entry into the nation universities (Awofala, 2017) as every prospective university student is expected to record at least a credit pass in mathematics to be eligible for admission into any Nigerian university.

Thus, mathematics is used as a critical filter for gaining entrance into the nations' tertiary institutions. While students suffer from their poor performance in mathematics, teachers in Nigeria are not left out in this show of shame as their mathematical content knowledge has been called to question. It is appalling to note that vast majority of mathematics teachers in the country have a narrow knowledge of the mathematics content they are expected to teach in the classrooms. This is a serious concern for every meaningful Nigerian as great nations of the world have relied on robust advancement in mathematics for meaningful technological progress.

Both the Soviet and American renaissance in technology had been fueled by rapid progress in the quality of mathematics teaching and learning in schools. Mathematics in technology renaissance of the 20th century aided the former Union of Soviet Socialist Republic (USSR) to launch the first earth satellite into space on November 4, 1957 (Awofala, 2010). In fact the solid rocket boosters—used to liftoff the first space aircraft was an engine designed based on mathematics precision. Similar feat was recorded by the Americans when Neil Armstrong became the first man to enter into the moon in 1969. Mathematics understanding fueled the technology renaissance that brought the cold war which was won by the Americans at the demise of the USSR in 1989.

In this new millennium, the world should envisage a 21st century renaissance greater than the first renaissance powered by the printing press. Today, the 21st century renaissance is being fueled by the digital computing and communication. Progress in advanced mathematics in the 21st century has made achievements in digital computing possible as the world is turning into a globally connected village. This gorgeous advancement in digital computing powered by mathematics has made essential developments in biotechnology, artificial intelligence, and nanotechnology possible.

The notches of precision with which we measure advances in engineering are a function of rapid progress in mathematics. This is because mathematics is the art of precision. In advance economies, engineers not only have the power to control photons of light with optoelectronics but are also operating at the atomic level with nanotechnology (Fisher, 2000). Mathematics in the 21st century is enabling capacity for prodigious technological leaps and rebirth. A renaissance is a period of constructive rebirth in reconsidering and positivity.

Fruitful mathematics has promoted societal anticipations of what mathematicians can achieve by lending critical support for technology innovations. Every country is in the race for robust technology expedition to improve living standard of her citizens. The world is seen not to be incapacitated by technology at least in this 21st century. While Nigerians may not have a positive perception of mathematics due to students' failure rate in it, it is expedient to ascertain the teachers' perception of the role of mathematics in technological renaissance of the 21st century. This is because the progress of a nation lies in the hands of her teachers.

If teachers at all levels are getting it right, then the nation is not far from the real development. It is a fact that no nation can rise above the quality of its teachers. Quality teachers lead to quality educational system which in turn leads to development. Successful educational system is sine-qua-non to national development. Nigerian teachers' sanguinity and capability to transformation will reinforce our path to the 21st century renaissance.

To this end, this study therefore investigated teachers' perception of the role of mathematics in technological renaissance of the 21st century.

1.1 Research Questions

The following research questions were stated for this study:

- RQ1. What is the level of teachers' perception of the role of mathematics in technological renaissance of the 21st century?
- RQ2. Is gender a significant factor in teachers' perception of the role of mathematics in technological renaissance of the 21st century?
- RQ3. Is discipline of study a significant factor in teachers' perception of the role of mathematics in technological renaissance of the 21st century?

2. METHODS

The study adopted a quantitative research method within the blueprint of a descriptive survey research design of an ex-post facto type. Education district three was randomly selected from the six education districts that make up Lagos State through a simple random sampling technique. I6 public senior secondary schools were randomly selected from 45 senior secondary schools in education district three. In all there were 235 teachers in the sixteen schools with 125 males and 110 females. The teachers ranged in age from 25 to 63 years with a mean age of 46 years (SD=4.6 years). All the teachers had a basic teaching qualification with varied areas of specializations (130 non-science teachers and 105 science teachers). One instrument named "teachers' perception of role of mathematics in technological renaissance questionnaire (TPMTRQ)" was used to solicit information on teachers' age, gender, qualifications, specialization and perception of the role of mathematics in technological renaissance. A five-point Likert scale with rankings from 1 (strongly disagree) to 5 (strongly agree) was adopted for the questionnaire.

The questionnaire which consisted of 11 items was given to a panel of experts for content and face validity. The members of the panel included five experts in measurement and evaluation from two public universities in Lagos State, Nigeria. The initial 15–items questionnaire was reduced to 11 based on experts' comments and decisions. 30 teachers from three senior secondary schools in education district three not part of the main study schools were used for pilot testing of the instrument. The results of the pilot study showed no obscurities in the instrument and produced a Cronbach's alpha coefficients 0.88 (for internal consistency reliability). One of the researchers and 15 other trained research assistants helped in the administration of the instrument to teachers in their respective schools. The participants were told that their participation was voluntary and any teacher not interested in the study could pull out of the study at any stage. The collected data were summarized and analysed using mean, standard deviation and independent samples t-test. Alpha was set *a prior* at .05.

3. RESULTS

Research Question One: What is the level of teachers' perception of the role of mathematics in technological renaissance of the 21st century?

A total score of perception of the role of mathematics in technological renaissance was computed from the 11 items questionnaire, ranging from 11 to 55. A score of 33 is the middle point so higher scores indicate a high perception of the role of mathematics in technological renaissance. A total of 235 teachers participated in the study, 126 (53.62%) had scores less than 33 (*M*=27.71, *SD*=2.96, score range: 20-32, 95%*CI*= 27.19–28.24), 24 had scores (10.21%) equaled 33 (M= 33, SD=0, score range: 33, 95%*CI*=33), while 85 (36.17%) had scores higher than 33 (*M*=38.32, *SD*=4.13, score range: 34-48, 95%*CI*= 37.43–39.21). A vast majority of these teachers had low perception of the importance of mathematics in technological renaissance.

In short, the overall *M*=32.09, *SD*=5.94, score range: 20-48, and 95%*CI*= 31.33–32.85 for the entire sample showed low perception of the role of mathematics in technological renaissance of the teachers.

Table 1. General pattern of teachers' perception of the role of mathematics in technological renaissance

No	Item Description	Responses in (%)				
		SA/A	U	SD/D	M	StD
1.	Math is the bedrock of technological renaissance	21.7	38.7	39.6	2.78	1.07
2.	Progress in math is a catalyst for technological renaissance	25.6	46.0	28.5	2.91	0.92
3.	Technological renaissance is not possible without math	29.3	39.6	31.1	2.91	1.01
4.	Math is the language of technological renaissance	14.1	43.8	42.1	2.68	0.85
5.	Math makes landmark achievement in technology possible	33.6	33.2	33.2	3.00	0.95
6.	No math, no technological renaissance	33.2	40.0	26.8	3.01	1.03
7.	Math literacy is a fuel for technological renaissance	24.7	43.4	31.9	2.93	0.93
8.	Quality math education in schools is sine-qua-non to technological renaissance	23.4	42.1	34.5	2.87	0.98
9.	Without quality math education in schools, technological renaissance will be elusive	21.7	47.7	30.6	2.91	0.91
10.	Thinking technological renaissance is thinking mathematics	29.8	42.1	28.1	3.02	0.98
11.	Math precision makes technological renaissance feasible	29.3	42.6	28.1	3.05	1.04

SA/A=strongly agree/agree, U=undecided, SD/D=strongly disagree/disagree, M=mean, StD=standard deviation

Table 1 above showed a general pattern of teachers' perception of the role of mathematics in technological renaissance. As observed from the table, 39.6% of the teachers strongly disagreed/disagreed that math is the bedrock of technological renaissance (**Item 1**) while 38.7% were undecided. 46% of the teachers were undecided that progress in math is a catalyst for technological renaissance (**Item 2**). 39.6% of the teachers were undecided that technological renaissance is not possible without math (**Item 3**). 43.8% of the teachers were undecided that math is the language of technological renaissance (**Item 4**). 33.6% of the teachers strongly agreed/agreed that math makes landmark achievement in technology possible (**Item 5**). 40% of the teachers were undecided that no math, no technological renaissance (**Item 6**). 43.4% of the teachers were undecided that math literacy is a fuel for technological renaissance (**Item 7**). 42.1% of the teachers were undecided that quality math education in schools is sine-qua-non to technological renaissance (**Item 8**). 47.7% of the teachers were undecided that without quality math education in schools, technological renaissance will be elusive (**Item 9**). 42.1% of the teachers were undecided that thinking technological renaissance is thinking mathematics (**Item 10**). 42.6% of the teachers were undecided that math precision makes technological renaissance feasible (**Item 11**).

Research Question Two: Is gender a significant factor in teachers' perception of the role of mathematics in technological renaissance of the 21st century?

The results in Table 2 below revealed that male teachers recorded slightly lower mean score (M=31.69, SD=5.47) than their female counterparts (M=32.55, SD=6.43) on perception of the role of mathematics in technological renaissance of the 21st century. This lean mean difference in perception was statistically not significant $t_{(2, 233)} = 1.11$, p=.27. Therefore, it was concluded that gender is not a significant factor in teachers' perception of the role of mathematics in technological renaissance of the 21st century.

Table 2. Independent samples t-test analysis of teachers' perception of the role of mathematics in technological renaissance of the 21st century based on gender

Gender	N	M	SD	SEM	Df	t	p
Male	125	31.69	5.47	.48	233	1.11	.27
Female	110	32.55	6.43	.61			

Research Question Three: Is discipline of study a significant factor in teachers' perception of the role of mathematics in technological renaissance of the 21st century?

The results in Table 3 below showed that non-science teachers recorded slightly lower mean score (M=31.70, SD=6.05) than their science counterparts (M=32.57, SD=5.80) on perception of the role of mathematics in technological renaissance of the 21st century. The lean mean difference in perception was statistically not significant $t_{(2, 233)}$=1.12, p=.26. Therefore, it was concluded that discipline of study is not a significant factor in teachers' perception of the role of mathematics in technological renaissance of the 21st century.

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Table 2. Independent samples t-test analysis of teachers' perception of the role of mathematics in technological renaissance of the 21st century based on discipline of study

Gender		N	M	SD	SEM	Df	t	p
Non-science		130	31.70	6.05	.53	233	1.12	.26
Science	105	32.57	5.80	.57				

4. DISCUSSION

The teachers who willingly took part in this study tend to accept one of the 11 favourable statements made about the role of math in technological renaissance, did not accept one of the 11 favourable statements and were on undecided on nine of the 11 favourable statements. This finding showed that teachers do seem to have no opinion on most of the statements (about 82% of the statements) made about the role of mathematics in technological renaissance in the 21st century. This is an indication that the role of mathematics in technological renaissance is not well perceived by teachers in Lagos State. The low perception of teachers on the role of mathematics in technological renaissance showed that most teachers in the study were indifferent simply because they could not see the tangible effect of mathematics on technological developments. Their perception of mathematics as an abstract subject (Awofala, 2012) might have led them to view mathematics as inconsequential in the development of technology. This unfavourable finding showed that mathematics has not taken its rightful position in Nigeria. No wonder students show negative attitudes toward mathematics and their performance in it is appalling. If teachers could see no relevance of mathematics to technological development, then they cannot persuade students to study and have a flair for mathematics.

The present study showed that gender was not a significant factor in teachers' perception of the role of mathematics in technological renaissance of the 21st century. This showed that the role of gender in affect in mathematics education could be dissipating. The finding showed that both male and female teachers face comparable challenges, experiences and exposure (Ifamuyiwa & Kehinde, 2011; Awofala, Ola-Oluwa & Fatade, 2012) in relation to the role of mathematics in technological renaissance of the 21st century.

As indicated by the result of this study, participating teachers regardless of their gender have shown low perception of the role of mathematics in technological renaissance despite their agreement that mathematics makes landmark achievement in technology possible.

This study found that discipline of study (science and non-science) was not a significant factor in teachers' perception of the role of mathematics in technological renaissance of the 21st century. The non-significant influence of discipline of study on teachers' perception of the role of mathematics in technological renaissance of the 21st century is explicable bearing in mind the fact that all the teachers had at one time or the other studied mathematics either at ordinary level or at advanced level. Their study of mathematics seemed not to have made any difference in their perception of the role of mathematics in daily life. It appears that the science teachers did not catch the importance of mathematics in technology development upon their years of study mathematics and mathematics-related courses at the tertiary institutions.

5. IMPLICATIONS FOR INNOVATIONS AND PRODUCTIVITY

This study has provided an empirical base for supporting the low perception of the role of mathematics in technological renaissance of the 21st century by teachers regardless of their gender and discipline of study. Gender and discipline of study were found to have no significant influence on teachers' perception of the role of mathematics in technological renaissance of the 21st century. The low perception has implications for innovation and productivity in Nigeria. First, teachers in Nigeria using Lagos State as a point of reference have not internalized the role of mathematics in technological developments. They were less to believe that gorgeous advances in technology developments were made possible through mathematics literacy. Innovations in technology could not have arisen in the developed world if mathematics teaching and learning was not at the front burner. Nigerians need to change their low perception of mathematics as a course for engineering discovery and rebirth. Innovations in technology which could impact productivity will not surface if mathematics is taught shabbily in schools and teachers found no relevance of mathematics to their everyday life.

To enjoy innovations and productivity in every sphere of human development, mathematics teaching and learning must be accorded its rightful place. Scientific and technological ingenuities cannot be achieved without progress in mathematics and progress in science and technology produces innovations that enhance productivity leading to economic development. Second, the low perception of teachers on the role of mathematics in technological renaissance could undermine the teaching of mathematics in secondary schools. Since graduates of secondary schools are fed into the universities in Nigeria, their low perception of the role of mathematics in technological renaissance handed to them by their teachers may prevent them from studying mathematics and mathematics-related courses at the universities. This may inevitably lead to shortage of manpower in science, technology, engineering, and mathematics (STEM) fields which could undermine the nations' quest for technological development. Shortage of manpower in STEM fields may lead to dearth of innovations in every sphere of human endeavour thereby undermining productivity. For innovations to be ubiquitous and productivity enhanced STEM fields must be allowed to flourish and citizens must be seen making frantic efforts to earn careers in STEM.

6. RECOMMENDATIONS

The findings of this study have shown the need to have re-orientation and advocacy programmes in mathematics instituted in schools across the nook and cranny of this country. The low perception of teachers on the role of mathematics in technological renaissance points to the fact mathematics teaching and learning is done in schools without applying it to everyday life of the students. This way students may not see the justification for studying mathematics and mathematics-related courses at the university which may hamper the production of workers of STEM. The agency like the Nigerian Mathematical Centre (NMC) should be grossly funded as paucity of funds is always a song in the centre. Qualified teachers with sound pedagogical intelligence should be recruited into the nations' schools to teach mathematics meaningfully. National Merit Awards should be given to outstanding mathematics teachers at all levels of the educational system. Nobel Laureate in mathematics should be instituted in the country and outstanding individuals who have contributed to the advancement of mathematics should be rewarded with it.

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