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National Mathematical Centre – Mathematics Improvement Project (NMC-MIP): A Project Transforming the Mathematics Performance of Students

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Abstract

The historical perspective of the deplorable mathematics West African Senior Secondary Certificate Examination (WASSCE) performance in the Nigerian secondary schools is explicated upon. National Mathematical Centre (NMC) created Mathematics Improvement Project (MIP), and the project produced germane instructional materials as tools and weapons to banish all the weak and faulty mathematical foundations in MIP (experimental) schools. To achieve this, the NMC resource personnel relying on these instructional materials, trained the MIP teachers and students to effectively use active or model teaching methods to teach and learn mathematics concepts in the curriculum.

The impacts of this project (MIP) on students and teachers taken part are tremendous and fulfilling. The mathematics WASSCE high success rate in project (MIP) schools exemplified this. This is even more so (1) using descriptive statistics when comparison is made between mathematics WASSCE nationwide performances before and after the inception of MIP, (2) using non-parametric statistics when comparison is made between mathematics WASSCE performances for MIP and non MIP students in Kogi State.

Key words: MIP sermon, instructional system, model teaching, project sustainability, electronic classroom mechanism, significance of difference between two proportions.

Introduction

> *Mathematics is the gate and key of the sciences. Neglect of Mathematics works injury to all knowledge, since he who is ignorant of it cannot know the other sciences or the things of this world. And what is worse, men who are thus ignorant are unable to perceive their own ignorance, and so do not seek a remedy.*
>
> *Kline (1972) quoting Roger Bacon.*

Today, Mathematics is the linchpin in the task of national capacity building in science and technology and therefore, any shortcomings in this subject constitute drawbacks to the achievement of our science and technology objectives or rather, the Millennium Development Goals (MDGs) and the transformation agenda (Adetula, 2010; Ugoh, 1980). This remark was precisely synonymous to what Fafunwa (1995), former Minister of Education predicted some years ago, when he succinctly professed: "science and technology have become a dominant cultural factor, and any nation who is not alive to this fact is either dead or dying"; And as an appendage, it can be quickly added that "mathematics is the best cognitive tool that moves these science and technology activities in today's technological globalization".

This statement is true because without the knowledge of mathematics (head of all knowledge that often gives highly impressive accomplishments), there is no science, without science there is no modern technology, and without modern technology there is no modern society (Ale and Adetula, 2010). The message is clear. The prosperity of any country and the development of mathematical sciences are intimately connected.

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Historical Background

One undisputable or irrefutable fact is that the students' WASCE/ WASSCE poor performances throughout the Federation over the years in this subject called mathematics are reflection, at least in part, of the poor state of teaching and learning processes in the Nigerian schools and a serious indictment on secondary education in Nigeria.

The two data below speak volumes in regard of the sorry state of the performances of students nationwide over the years in mathematics in West African School Certificate Examination (WASCE, prior to 1986), and West African Senior School Certificate Examination (WASSCE, after 1986).

The first data depicted below is the sample of the yearly average mathematics performance of students nationwide in (WASCE) from the inception of secondary schools in Nigeria until 1985, (note, the results prior to 1964 are not significantly different). During this period, mathematics was compartmentalized into arithmetic, algebra processes, geometry, trigonometry and statistics/ probability. That is, each of the five branches of mathematics is considered a closed and separate field of teaching and learning. This is the classical view point of mathematics.

Year	**1964**	**1967**	**1969**	**1981**	**1982**	**1983**	**1984**	**1985**
% pass (at Credit level	6.9*	7.8*	8.59	6.26	13.30	9.42	11.26	11.45

Source: WAEC, except * that are from secondary source.

The performance of students in mathematics WASCE during classical view point of mathematics was nothing to write home about; hence a contemporary view point of mathematics came into being, following the Benin Mathematics Conference in 1976. Actually, this was the effect of *sputnik* and the ripples and waves on *modern mathematics* that generated all over the world then (Adetula, 1981). The conference resolution recognized that certain fundamental concepts (e.g. set relations and mappings) underpinned all the branches of mathematics, and that structural concepts gave possibilities for organizing all mathematics into a unified body of knowledge. It was claimed that this structuring permits greater understanding and efficiency in learning, and uncovers concepts and theories previously hidden by the traditional separation. For this reason, a unified secondary school curriculum (three years each for junior and senior secondary) was adopted, and National Mathematics Curriculum Guides for schools (based on contemporary view point) were released in March 1979 by Federal Ministry of Education. Effective usage of these curriculum guides by many Junior Secondary Schools started in 1981 (Adetula, 1989), and therefore Senior Secondary School started in 1984. Apart from putting in place a unified curriculum, the effort of Mathematics Association of Nigeria (MAN) to assist mathematics teachers (by conducting teacher training mathematics workshops) on how to teach the contents of this unified curriculum must be applauded, and the slogan *war against poor performance in mathematics* was declared. Again, notwithstanding all these efforts, the performances of students nationwide in mathematics in West African Senior Secondary Certificate Examination (WASSCE), beginning from 1986 were as poor as the result of WASCE under classical view point of mathematics. Sample of these performances are depicted in the second data below.

Year	1986	1989	1991	1997	1998	1999
% pass (at Credit level	10.83	8.78	11.13	7.62	10.91	18.07

Source: West African Examination Council (WAEC), 2000.

The National Mathematical Centre (NMC) that was established in 1988 and started functioning in 1989 was not ignorant of the depressing mathematics situation in Nigerian schools. The Centre has a mandate among others to promote the power and potentials of mathematics among the secondary school teachers and students, which will in turn enhance the social, commercial, scientific, industrial and technological development of the nation. One slogan the Centre shares very much is that '*Any nation that treats the mathematics education of her youths with levity does so at her own scientific and technological peril'*. Therefore, to achieve this particular mandate, the Centre in 2002, embarked on a project - *Mathematics Improvement Project (MIP)* as a panacea to remedy the appalling mathematics situation in the schools. The author, who played a leading role in the activities during the *war against poor performance in mathematics,* was given a job as a Resident Consultant (MIP) to develop a proposal for NMC Mathematics Improvement Project, coordinate the project implementation throughout the country and also write research reports to cover the project evaluation activities.

NMC-MIP, like any other Mathematics Improvement Project: Chicago, Michigan, North Carolina, Florida, Iowa City, Johannesburg, (Larmer, 2010; Ulm, 2011; Deubel, 2014) is a research study on the improvement of

depressing mathematics teaching and learning at senior secondary schools. Therefore, the Project's main goal is to use the model of Instructional System designed by Romberg (1968), and modified for MIP by Adetula (2002), to promote (through workshops' activities within two years) the roles of mathematics teachers (class teaching, student assessment and managerial activities) as well as the roles of students to learn mathematics with ease. *This will translate to students' greater performance measurable by the number of credit passes in the public mathematics examinations (e.g. WASSCE).*

The other purpose of this paper is on contemporary experience sharing in project research management, where other countries in the world can benefit after reading this report. Finally, one best way in carrying out a good research lies in an effective combination (hybrid) of qualitative (descriptive) and quantitative techniques exhibited in this paper.

Model: Basic Components of MIP Instructional System

For clarity sake, the model of MIP Instructional System depicted in Fig 1 below is used as a framework for the examination of NMC- MIP.

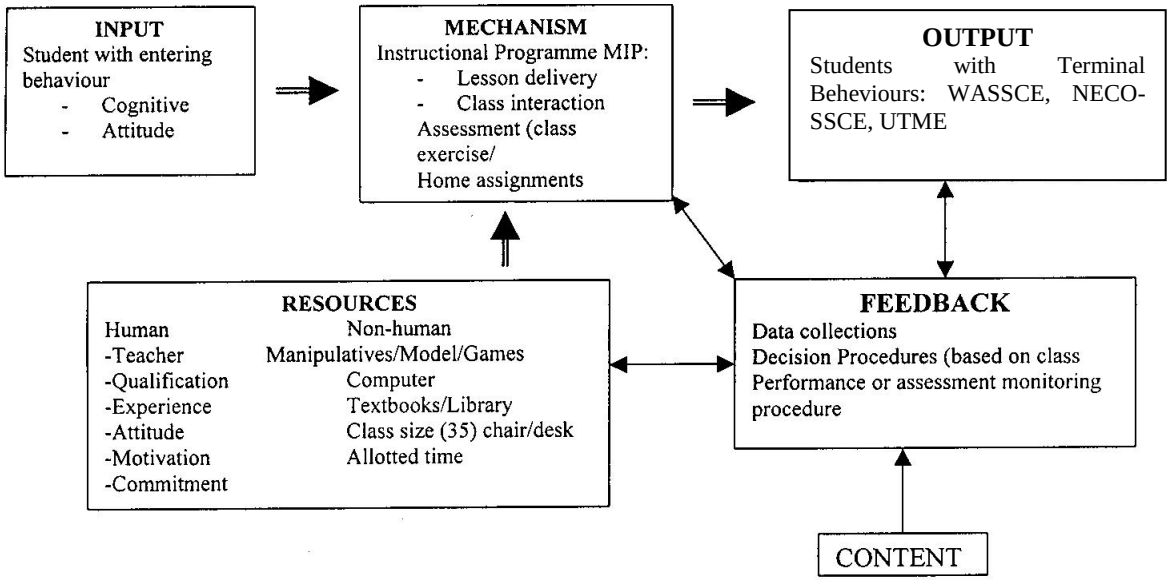

Fig 1: Model of MIP Instructional System.

The word system here refers to a 'man-made, controlled, functional structure'.

- A man-made structure is one that has interdependent components that can be changed or manipulated
- Controlled means that there is a feedback or monitoring procedure that can be used to manage the system.
- Functional means that the system is goal-oriented with a stated purpose or intent.

This system has five basic components: Input, Output, Mechanism, Feedback and Resources. Though the focus of this instructional system is not on content (since the competence of Nigerian Educational Research and Development Council -NERDC-, that specializes in producing *National Mathematics Curriculum Guides* is never in doubt), but it must be noted that the content is shown in the model leading to the feedback element; this implies that content helps define the boundary conditions within which the system operates.

The MIP instructional system has students as input; here, the current state of the art for each student as regards his/her cognitive and attitudinal behaviours can be determined using questionnaires on entering behaviours (Adetula, 2013a). These same students with changed behaviour (after going through the instructional and awareness workshops, i.e. after the intervention) became the output. The instructional programme that relied on training workshops and effective classroom lessons is explicated under the description of MIP teaching

methodology exemplified in model teaching method. Actually, description of this instructional methodology encompasses the mechanism or instructional program (lesson delivery and class interaction), and feedback (assessment and monitoring procedures).

The resources which are human (e.g. mathematics teachers), and non-human (e.g. NMC instructional materials: manipulative models, games, computers, textbooks, charts, workbooks, instructional and curriculum guidelines) make instruction easy, interesting and meaningful.

Method

Subjects

The subjects for the study were drawn from one major source. All second year senior secondary - SS2 students and the teachers of schools selected for MIP project by the interested State Governments in Nigeria that keyed into the project (but at different period). These States and periods are Katsina (2002/2003 and 2003/2004) academic years; Zamfara (2004/2005 and 2005/2006); Ondo (batch I) (2006/2007 and 2007/2008); Ondo (batch II) (2008/2009 and 2009/2010); And Kogi (2009/2010 and 2010/2011) academic years

For the project, each State Government selected six schools (made up of two schools in each of the three senatorial districts in the State for wider coverage), targeting in each school, SS2 students at the academic year inception of the project. The study followed the target students to SS3 in the following academic year until they sat for their WASSCE. Therefore, the project is a two academic year longitudinal intervention.

The data of MIP students and mathematics teachers in the four States is depicted on Table 1.

Table 1*: Data of MIP Students and Mathematics Teachers in Four States.*

	Requirements	**Katsina**	**Zamfara**	**Ondo**		**Kogi**
				Batch 1	Batch 2	
(i)	No of students in MIP schools	5380 (1403)	5010 (1298)	2481 (716)	2762 (792)	3128 (1081)
(ii)	Total No of teachers in MIP schools	34	33	17	19	12
(iii)	Total No of qualified MIP teachers	9	4	10	11	9
(iv)	Students/Qualified teacher ratio	598:1	1253:1	248:1	251:1	348:1
(v)	Average No of students/ class	86	104	50	54	53

- The data here is for the 'pulled' six selected senior secondary schools per State
- Number in parenthesis is the project students

Procedure

Two major procedural activities in MIP (experimental) schools can be identified thus:

First, the SS2 students' strengths and weaknesses in mathematics (skill and content domains) are determined together with the school mathematics staff strength and their difficult areas to teach. In addition WASSCE previous years' results are all collated. This constitutes the base line and the needs assessment.

Secondly, These difficult topics in mathematics are addressed using student/ teacher training mathematics workshops and effective classroom lessons that often rely on NMC expertise and germane instructional materials.

Clearly, each workshop is believed to re-engineer and to reformate the MIP teacher's roles to demonstrate such characteristics as:

- A deeper and more flexible content knowledge in the curriculum.
- Commitment to students and their learning to transform those students into mathematical dynamo.

• A wide repertoire of mathematics teaching strategies e.g. questioning techniques leading to active/ model teaching with a focus on meaning and class interaction; And the use of relevant instructional materials like NMC mathematics kits which are sources of valuable insight and intuition for the students.
• Class interaction that stresses teacher-student communication that promotes or builds student confidence, interest, self concept, and persistence.
• An effective performance assessment and portfolio evaluation technique, e.g. evaluation technique that emphasized logical process instead of product.

It is generally believed that the teaching and learning of mathematics are complex enterprises and that one of the best ways out is exemplified in active or model method of teaching/ learning mathematical concept with the view of eliciting meaning and gaining more understanding in the concept. Now let us consider one each of such active/ model teaching for MIP students in trigonometry, algebra, and geometry. These examples as highlighted below for MIP teaching episodes are merely representative and not exhaustive.

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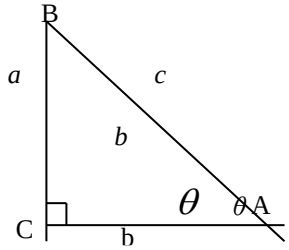
Model Method of Teaching Special or Quadrantal Anales (0º, 90º, 180º, 270º) of Triaonometrical Functions

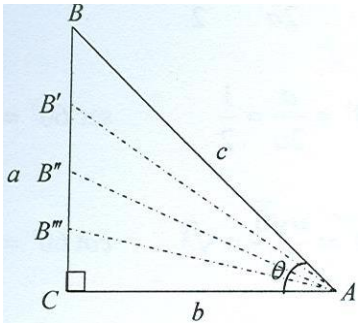
In a right angle ΔABC

$\cos\theta = \frac{b}{c}$ $\sec\theta = \frac{c}{b}$
$\sin\theta = \frac{a}{c}$ $\cos ec\theta = \frac{c}{a}$
$\tan\theta = \frac{a}{b}$ $\cot\theta = \frac{b}{a}$



Will we still have a right angle ΔABC if θ = 0º? or θ = 90º?

In the right angle triangle ABC, consider what happens when θ started decreasing. First point *B* moves to point B'.



Then to point B'', … and finally, as point *B*

tends to point *C*, i.e., as $\theta \rightarrow 0^o$.
$\Rightarrow a \rightarrow 0$ and $c \rightarrow b$.

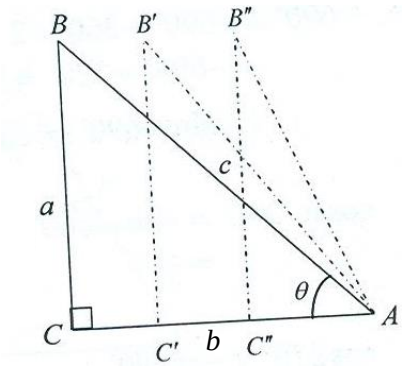
Hence,

$\sin 0^o = \frac{0}{b} = 0$ $\quad$ $co\sec 0^o = \frac{b}{0} = \infty$

$\cos 0^o = \frac{b}{b} = 1$ $\quad$ $\sec 0^o = \frac{b}{b} = 1$

$\tan 0^o = \frac{o}{b} = 0$ $\quad$ $\cot 0^o = \frac{b}{o} = \infty$

In the right-angled ΔABC, consider what happens when θ started increasing. First point *C* moves to C' as *B* moves to B', then to C'' as B' moves to B''. Finally, as *C* tends to point *A*, $b \rightarrow 0$, $\theta \rightarrow 90^o$ and $a \rightarrow c$.



Hence

$\sin 90^0 = \frac{c}{c} = 1$ $\quad$ $\cos ec 90^0 = \frac{c}{c} = 1$

$\cos 90^0 = \frac{o}{c} = 0$ $\quad$ $\sec 90^0 = \frac{c}{o} = \infty$

$\tan 90^o = \frac{c}{o} = \infty$ $\quad$ $\cot 90^0 = \frac{0}{c} = 0$

Strictly speaking, angles 0^o and 90^o cannot appear in a right angled triangle as acute angles, but in an extended view of trigonometric functions, we just have to consider their values. (Note that the foundation of the concept of limit is been cultivated here). The symbol ∞ (infinity, which is not a number) indicates that the absolute value of the quantity increases without bound.

Model Method of teaching the concept of the Difference of two Squares (An algebraic identity).

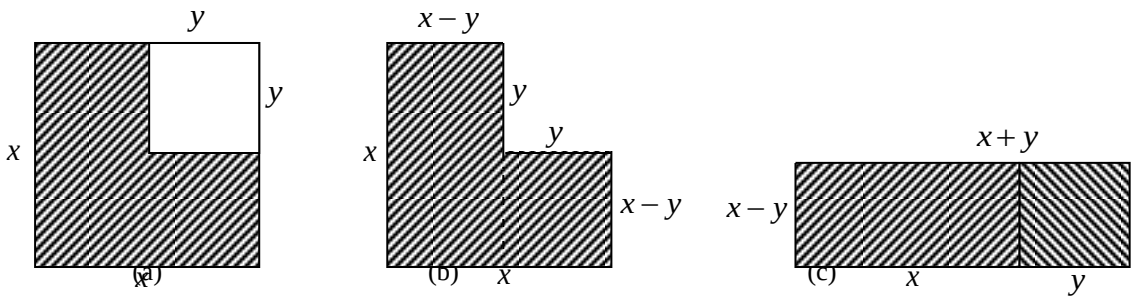
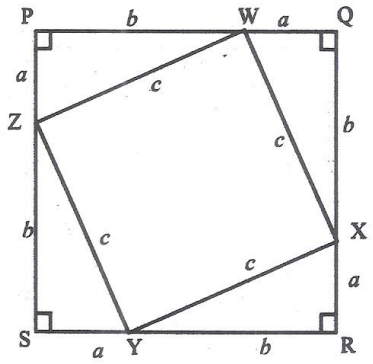


Fig. 2

In the above model (fig. 2), a square whose area is designated by y^2 is placed on a square whose area is x^2, so that the shaded portion shown in (a) is a representation of $x^2 - y^2$. The shaded region is subdivided as shown in (b) and re-arranged as in (c) to illustrate that $x^2 - y^2 = (x - y)(x + y)$. This shows clearly that the model not only promote but can be used to enrich learning.

Model Method of Teaching Pythagoras Theorem. (A geometric identity).

Proving the Pythagoras Theorem invoking the Chinese proof is very ingenious.



Area *WXYZ* = c^2
Area *PQRS* = $(a + b)(a + b) = a^2 + b^2 + 2ab.$ …… (i)

But Area *PQRS* = Area of *WXYZ* + Area of 4 triangles
= $c^2 + 4 \times ½\ ab$
= $c^2 + 2ab$ …… (ii)

Equating (i) and (ii) to get

$c^2 + 2ab = a^2 + b^2 + 2ab$

i.e. $c^2 = a^2 + b^2$

The suggested active method of teaching enable students to discover the truths for themselves before formal proof of propositions is introduced. Quite often these formal proof of proposition normally fogs students' mind without active method of teaching. It must be clearly stated here that students (especially non-MIP) are given these trigonometric functions and fundamental identities (algebraic and geometric) as definition to memorize without any meaning. In fact their memorization of these functions, which is synonymous to rote-drill and practice (parroted and catechetical procedures), did little to promote conceptual efficiency; instead dampen and deaden the students' enthusiasm, and also retention of their mathematical learning. The story of Bertrand Russell on this issue is fascinating. Bertrand Russell said 'that the beginning of algebra, he found far more difficult than geometry, perhaps as a result of bad teaching. He was made to learn by heart *the square of the sum of two numbers is equal to the sum of their squares increased by twice their product.* He said, he had not the vaguest idea of what this meant, and when he could not remember the words, his teacher threw the book at his head, but did not stimulate his intellect in any way.' (Russell, 1968, p. 31)

From the foregoing, it is discovered that MIP *lesson delivery* aims at presenting a clear and structured unique active/ model teaching methodology, which promotes and supports the classroom spirit of inquiry and problem solving (Adetula, 1988; 2010; & 2012). It is this inquiry that truly drives the students' learning, not a teacher telling them (the students). In addition, effective monitoring and various internal evaluation activities carried out are to assure that students are not classified to be mathematically empty (Adetula, 2013a & 2013b).

At this juncture, it must not be misconstrued that using a teaching model is the only magic bullet for mathematical success. According to MIP sermon (Adetula, 2005), it is clearly pointed out that the other dimension apart from active teaching is to build into the students the awareness that they can succeed in mathematics once they believe in themselves to succeed. MIP sermon also dwelt on the power, value, and utility of mathematics during a session in the MIP workshop. This stress the smooth applicability of mathematics to the real world, so as to demystify a number of stereotypical attitudes students have towards mathematics. The summary of MIP sermon is given below.

The mathematical sermon for MIP students.

This is the spiritual or awareness dimension of the project working on the students' mindset. That is, the sermon works on student's thought processes to believe in self as an achiever that can succeed in mathematics through the power of almighty God and hard work. The slogan is: '*You may succeed if nobody else believes in you, but you will never succeed if you don't believe in yourself*'. Simply put, this is a sermon that:

inspires student to mathematics success,
energizes him (or her) for achievement,
liberates him (or her) from career limitations,
frees him (or her) from mathematical fear,
brightens up his (or her) pathway, and
makes his (or her) dreams/ aspirations come true.

The prayer that follows by each student is simple, and thus:

O Lord, let me be able to fulfill my mathematical learning roles, so that the mathematical light as detailed in this sermon will shine upon alter of my life.

Research Instruments

The research instruments used national examinations. That is, what are considered in this project are *external evaluation activities,* like national examinations. Unlike test instruments constructed by a researcher, the validity and reliability of these national examinations produce indubitable and irrefutable conclusions and cannot be concocted.

Actually, performance of SS3 target students on Senior School Certificate Examination (SSCE) conducted by Examination Councils like West African Examination Council (WAEC) and National Examination Council (NECO), and also performance of these students on other public placement examination like Unified Tertiary Matriculation Examination (UTME) to higher institutions conducted by Examination Board like Joint Admission and Matriculation Board (JAMB) always determine in no small measure the positive effect of MIP. However, the analysis of MIP results in this paper focused on mathematics WASSCE.

Results

Record of WASSCE Achievement in MIP States: By Descriptive Statistics

The impacts of this project (MIP) on students and teachers taking part are tremendous and fulfilling. After the two year intervention programme, sufficient number (at least, 90%) of MIP school teachers, inclusive of all the teachers teaching project students, have been trained during MIP workshops on how to use the NMC instructional materials as tools, weapons and arsenals to banish the weak and faulty mathematics foundation in project schools, and thereby transforming the students to become mathematical dynamos.

Actually, it is considered at this point that if the students are to be brought to the frontiers of mathematical knowledge, then the prime role of the teacher is to determine the whereabouts of these frontiers which often reside in the NMC germane instructional materials. Clearly, this role, the teachers have carried out efficiently as indicated below in the mathematics results of MIP students. These results are exemplified by the percentage of at least credit passes in the public examinations (WASSCE), and the following data (Adetula, 2012), solidify and concretize this point.

In Katsina State the average performance of six MIP pilot schools in Mathematics WASSCE in 2004 was 47%. Before MIP intervention, it was 3.8%.
In Zamfara State in 2006, it was 76%, and 14% before the intervention.
In Ondo State (Batch 1) in 2008, it was 77%, and 41% before the intervention.
In Ondo State (Batch 2) in 2009, it was 81%, and 48%, before the intervention.
And in Kogi State in 2011, it was 72%, and 19% before the intervention.

For clarity sake, MIP Kogi State detailed results will be used for illumination. These results are indicated below in Tables 2.
The data displayed on Table 2 indicated the success rate in mathematics WASSCE in the MIP schools in Kogi State. The analysis of the results revealed that the average performance (in at least credit pass) of six MIP schools in mathematics WASSCE is 72%. However, when pass level (D7 & E8) is also considered, the average total pass is 90%.

Table 2. *Comparative Analysis in Mathematics SSCE Results (at least Credit pass) in the six MIP-Pilot Schools in Kogi State*

		Year 2009 Mathematics Results before the Commencement of MIP Project		Year 2010 Mathematics Results (MIP Project did not involve these students)		Year 2011 Mathematics Result after Two Years of MIP Project	
S/N	Name of School	No. of Candidate	A_1 - C_6 % Pass	No. of Candidate	A_1 - C_6 % Pass	No of Candidate	A_1 - C_6 % Pass
1	Govt Sc Sec Sch, Icheke-Ogane (GSSS, Icheke-Ogane)	36	0.00	26	7.69	56	55.56
2	St. Peter's Coll Idah	244	54.10	212	33.02	175	70.86
3	Ochaja Boys Sc Sec Sch. Ochaja (OBSSS Ochaja)	76	0.00	86	No Results	88	97.75
4.	Abdul-Aziz Atta Memorial Coll, Okene (AAMC, Okene)	183	24.04	179	94.41	299	92.14
5.	Govt Sc Sec Sch. Ogaminana (GSSS Ogaminana)	239	12.55	273	1.83	181	53.04
6.	Govt. Sc. Sec Sch. Lokoja	218	9.63	215	11.16	282	57.09

The MIP project for the State started in year 2010 with SS2, the project was continued with these students in SS3 in year 2011. The average mathematics WASSCE result (at least credit pass) in the six MIP schools in 2011 (with total population 1081) is 72%.

To sustain the project in these schools, the project materials were retrieved from the MIP graduating set of 2011, and given to the immediate incoming set into SS3. Since the school mathematics teachers have been trained effectively to use these project materials and the State MIP Desk Officer (NMC officer who is a mathematics educator residing in the State to promote MIP activities) is still qualify to continue in organizing MIP workshops for these incoming students into SS3, then it is reasonable to conclude that the graduating students of the set 2012 will also perform well in mathematics WASSCE. Table 3 buttressed these facts. Clearly, the sustainability of the project is guaranteed through this process.

Table 3. *2012 Mathematics WASSCE Result: A Follow – up Effort for MIP Schools in Kogi State*

	Year 2012 Mathematics WASSCE Results.		
S/N	Name of School	No of Candidate	A_1 - C_6 % Pass
1.	GSSS, Icheke-Ogane	96	70.83
2.	St. Peter's College Idah	191	84.29
3.	OBSSS, Ochaja	48	22.92
4.	AAMC, Okene	121	80.17
5.	GSSS, Ogaminana	116	96.55
6.	GSSS, Lokoja	282	3.55

The poor performances of OBSSS, Ochaja and GSSS, Lokoja were as a result of sudden transfer of qualified mathematics teachers from these schools without immediate replacement. The message to be drawn from this is that without qualified teachers, the result of any school project will always be spurious and disastrous. Without GSSS Lokoja in the analysis of the result, the average mathematics WASSCE performance at credit level of the remaining five schools is 78.5%. This is really a good performance. With all these good performances, Is it save to claim that MIP is really preparing students for a smooth pilgrimage to advanced mathematics studies?

Effects of MIP on mathematics WASSCE performance nationwide.

The data below indicated the average national mathematics WASSCE results as from the year 2002 when MIP was established and various NMC sponsored national mathematics activities at senior secondary education level were vigorously pursued.

Year	**2002**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2012**
% pass at Credit level	34.41	34.51	38.23	41.54	46.90	56.96	45.33.	48.88

Source: WAEC Correspondence with National Mathematical Centre (2012),

In actual fact, there is a clear difference in these national mathematics WASSCE results as depicted above and the previous nationwide results earlier given in the background section of this paper.

The difference in performance to the previous performances before year 2002 is crystal clear. Actually, this significant improvement in performance as from the year 2002 is based on the commitment of the staff of the project using basic components of MIP instructional system and the effective MIP instructional materials that simplify, elementarise and even trivialize the mathematics concepts that students and teachers perceived to be difficult. In addition, it is also true that MIP staff vigorously pursued mathematics teacher training workshop using MIP instructional materials across many States in addition to MIP States. Therefore it is reasonable to conclude that MIP promotes national improvement in mathematics performance by using the active teaching style to attract and retain the attention of the students being taught. The MIP key words here are: attention, attraction, and retention.

By Inferential Statistics

It is necessary to determine if MIP students in Kogi State significantly performed better than the non-MIP students in mathematics WASSCE.
To carry out this, a purposive sample of six non-MIP schools were identified that best match the six MIP schools: in qualified teacher/ student ratio, and percentage credit performance in mathematics WASSCE before the intervention. This is to meet the assumption that the students in these two groups (MIP and non-MIP) are equivalent before the intervention as indicated on Table 4. Actually, it is reasonable to assume that purposive sampling is the best option, since there is no random sampling for the selection of MIP schools. The State Government just gave six schools by fiat (as MIP schools) for the project.

Table 4. *Comparison of Mathematics WASSCE results of MIP and non-MIP students in Kogi State using test of significance of a difference between two proportions*

S/N	Matching a) MIP and b) Non MIP Schools	Matching results in both MIP and non -MIP Schools prior to the intervention				Results: Comparing MIP schools with intervention and non MIP schools without intervention (2011)			
		2009		2010					
		N	n	N	n	N	n	Z	Decision α =0.01
1	a) GSS Icheke-Ogane	36	0 (0%)	26	2 (7.6%)	56	31	2.64	Sig.
	b) GSS Egume	222	2 (0.9%)	247	14 (5.7%)	256	97		
2	a) St. Peter's Coll. Idah	244	132 (54%)	212	70 (33%)	175	124	9.76	Sig
	b) CSS Adavi_eba	314	178 (56%)	332	113 (34%)	307	14		
3	a) OBSSS Ochaja	76	0 (0%)	86	0(0%)	88	86	6.86	Sig
	b) GSS Sarki-Noma	57	1(1.7%)	58	0(0%)	40	20		
4	a) AAMC Okene	183	44 (24%)	179	169 (94%)	299	25	23.0	Sig
	b) ECSS Ogaminana	235	88 (37%)	223	152 (68%)	362	12		
5	a) GSSS Ogaminana	239	30 (12%)	273	5 (1.8%)	181	96	13.68	Sig
	b) GSS Itobe	215	30 (14%)	246	4 (1.6%)	397	18		
6	a) GSSS Lokoja	218	21 (9.6%)	215	24 (11%)	282	161	5.49	Sig
	b) GSS Inye-Ankpa	130	11 (8.4%)	97	12 (12%)	100	25		
	a) All the six MIP Schools					1081	773	29.50	Sig
	b) All the six non MIP Schools					1462	186		

Key: N—Number of candidates;
n—Number that pass at least credit level (percentage in parenthesis)
Z—Calculated value of test statistic of a difference between two proportion

The data on Table 4 indicated that the mathematics WASSCE performances of MIP and non-MIP schools are equivalent (in 2009 and 2010) prior to project intervention. This is the main reason that made it possible to compare MIP school results in mathematics WASSCE after project intervention in 2011 with non-MIP school results that are without intervention.

To achieve this, a non-parametric statistics is invoked using the test of significance of a difference between two proportions, and the test statistic is given by:

$$Z = \frac{P_1 - P_2}{\sqrt{\left\{\overline{P}_e \overline{q}_e \left(\frac{N_1 + N_2}{N_1 N_2}\right)\right\}}}$$

Where P_1 and P_2 are two distinct populations for MIP and non-MIP schools.

$\overline{P}_e = \frac{N_1 P_1 + N_2 P_2}{N_1 + N_2} = \frac{n_1 + n_2}{N_1 + N_2}$ is the variance of the estimated population proportion as suggested by Fisher (Fisher, 1961 & Adetula, 2013c); And $\overline{q}_e = 1 - \overline{P}_e$

To apply these formulas, the illustration of comparing MIP school results in 2011 after the intervention and non-MIP school results without intervention is explicated using S/No 1 on Table 4 above thus:

In the project school (GSSS Icheke Ogane), 31 out of 56 passed, i.e. $P_1 = \frac{31}{56} = 0.55$

In the non-project school (GSS Egume), 97 out of 265 passed, i.e. $P_2 = \frac{97}{265} = 0.36$

$\overline{P_e} = \frac{31+97}{56+265} = \frac{128}{321} = 0.40$, then $\overline{q}_e = 1 - \overline{P}_e = 0.60$

$\therefore \overline{P}_e \overline{q}_e = 0.40 \times 0.60 = 0.24$

Applying the test statistic to get $Z = \frac{0.55 - 0.36}{\sqrt{0.24\left(\frac{56+265}{56\times 265}\right)}} = \frac{0.19}{0.072} = 2.64$

The hypothesis of no significant difference in performance (in mathematics) is rejected beyond the 0.01 level of confidence. Hence, the hypothesis that the two sample proportions arose from the same population is rejected. For others on Table 4, each test statistic was calculated and the decisions were all the same.

New Direction for MIP

MIP is introducing electronic classroom mechanism by producing mathematics software (lessons) of different topics into different media like CD, DVD, and memory card (Adetula, 2009). This idea, though at the nascent stage is predicated on the fact that in this 21st Century (electronic and entertaining era), the static media (books and kits) produced by the Centre for teaching and learning may be inadequate; hence the production of mathematics lesson software in different topics becomes a panacea. This is reasonable because in addition to all the advantages the NMC books and kits have, MIP users of this software will be more advantageous to learn at their own pace at their time. Also they can revise the lesson of a topic as many times (slow or fast) as possible and as desired (Adetula, 2012).

With these advantageous positions, many stumbling blocks to mathematics performance will be rooted out. Some of these stumbling blocks to opportunity to learn variables observed and not yet mentioned in the paper include:

- Student over-crowdedness in the classroom. MIP advocates 35 students per class. However MIP school survey revealed 50 to 104 students per class, as indicated on Table1.
- Unreasonable high teaching periods per week for mathematics teachers as a result of fewness in the number of these teachers.
- Even with the few mathematics teachers above, majority of them are not qualified to teach at the grade level they found themselves. Table 1 buttressed this also.
- Most students do not understand Basic English, the language of instruction. Research study supports this, not only at the senior secondary schools but even at the primary/ junior secondary schools that feed these senior secondary (Adetula, 1990).

Conclusion

That most students fail, dislike and fear mathematics is no longer news. But how this situation can be arrested is the focus of this research project. Therefore in this paper, the author has been able to show that Mathematics Improvement Project (MIP) in Nigeria is an attempt by the Centre to revamp mathematics teaching and learning at the secondary school level. In addition, the Project is designed to present a clear structured and unique teaching methodology that is characterized by active teacher participation and frequent monitoring of students' progress (activities and practices) using NMC germane instructional materials (MIP textbooks series e.g. Basic Mathematics Concepts, Teaching Modules, Students' Workbooks, Models, Games, …) and a "follow through" evaluation mechanism in business-like fashion. This is a "paradigm shift" from the old methodology of expository method to active teaching/ learning, where teachers will able to help students create cognitive maps, link ideas, address misconceptions, and reinforce meaning with teaching models. Such teaching for meaning in mathematics gives students an intellectual foundation to stand upon and a familiar framework to build upon. It also strengthens that framework, as demonstrated in the significance difference in mathematics WASSCE results that favoured MIP schools.

The fundamental conviction of NMC that the mathematics education community (not only in Nigeria but Africa and beyond) must share is that the NMC instructional model can often be used to enrich learning, for it allows students to respond to questions actively and enthusiastically. Note that this visual evidence not only stimulates interest, but help to build mathematical meaning and eventually allow the students to grow and glow mathematically. For all these reasons, it is reasonable to assert that any NMC-MIP teacher will never be involved in presenting a mathematics lesson that is barren, boring, dry, dull, vague, and uninspiring. Such these presentations that allow students to learn mechanical mathematics procedures (mechanistic approaches) for getting answers with little or no understanding to support them are forbidden in MIP teaching episodes.

NMC also noted (Ale & Adetula, 2010), that the most critical element of the education equation is the classroom teacher, and if Nigeria is to have a world –class schools with products of scientific and technological potentials that will achieve Millennium Development Goals, and scientific and technological transformation, then it must have world- class mathematics teaching force. For this reason, the major goal of MIP as clearly stated in the paper is to promote, re-awaken, reactivate, re-energize and re-vigourize the roles of mathematics teachers, as well as the roles of the students to learn mathematics with ease. Consequently, students will excel in mathematics WASSCE with flying colours, as exemplified in Katsina, Kogi, Zamfara and Ondo MIP schools

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