

DEVELOPMENT OF PROFESSIONAL LEARNING SCHEME TO IMPROVE TEACHERS' COMPETENCE IN THE TEACHING OF DIFFICULT TOPICS IN SSCE MATHEMATICS IN ABEOKUTA, OGUN STATE

by

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INTRODUCTION

Background to the problem

A professional development is all about an improvement to our professional thinking, knowing, feeling and doing. They are encompassed in the three main inter-related components namely behavioural, attitudinal and intellectual components (Reeves, 2018). The desired change in behaviour can be achieved if the attitudes and ways of thinking are reframed to bring about the winning over of hearts and minds. It is such desired change in attitude and thinking that constitutes the focus of any professional development programme.

For teachers, the development of learning scheme, simply termed 'professional development', refers to activities that are an integral part of school and local educational agency strategies for providing educators (including teachers, principals and other school leaders) with the knowledge and skills necessary to enable students to succeed in a well-rounded education aimed at meeting the challenging academic standards (Darling-Hammond, Hyler and Gardner, 2017; Reeves, 2018). Many studies showed that students learn more from teachers with strong academic skills than they do from teachers with weak academic skills (Meroni, Vera-Toscano and Costa, 2015; Tichovolsky, Kupersmidt, Voegler-Lee and Arnold, 2015). The findings are so consistent that there is a broad agreement that teachers' academic skills are linked to students learning (Blazar and Kraft, 2017).

Professional development of teachers therefore include activities that improve and increase teachers' knowledge of the academic subjects the teachers teach, understand how students learn, and ability to analyse student work and achievement from multiple sources, including how to adjust instructional strategies, assessments, and materials based on such analysis. It can be an integral part of a broad educational improvement plans which allows personalized plans for each teacher to address the specific needs identified in observation or other feedback, improves classroom management skills, advances teacher understanding of effective instructional strategies that are evidence-based; and strategies for improving student academic achievement or substantially increasing the knowledge and teaching skills of teachers (Popoola and Adegoke, 2014; Glackin, 2018).

Professional development must necessarily entail an extensive participation of teachers, principals, other school leaders, parents, and administrators of schools. It provides training for teachers in the use of technology and technology applications in the classroom to improve teaching and learning in the curricula and academic subjects in which the teachers teach. Teachers' activities are regularly evaluated for the impact of such scheme on increased teacher effectiveness and improved student academic achievement, and the findings of the evaluations are used to improve the quality of teachers' professional development (Darling-Hammond, Hyler and Gardner, 2017). This study is particularly aimed at the

development of professional learning scheme and its impact on teachers' competence at teaching difficult topics in ordinary level mathematics.

Statement of the Problem

Performances of students in mathematics have always been below expectation and this has been a source of concern to stakeholders in education. Among the concerned groups of the stakeholders are the secondary school teachers of mathematics in Epe Local Government Area of Lagos State. The teachers started a reform of Mathematics education through organisation of regular meetings. The teachers focused on enhancing teaching competence using instructional materials in Mathematics. They adopted instructional practices that make students' learning visible. There were records of improvement in students' achievement in mathematics in the schools where the group members teach. The programme, however, is an informal one, and there is no empirical data on monitoring of the group and its activities. However, the group's activities revealed a unique instructional approach that deserves replication for the purpose of capturing it in a broad-based scheme that could be applied to other subjects within school curricula at any level.

It was intended that, through the development of Professional Learning Scheme in Ogun State, the foundational problem of teachers' lack of competence in some topics where students performed poorly, according to Chief Examiners' Reports, would be addressed thereby enhancing teachers' confidence and bringing better achievement for mathematics students.

Research Questions

The following were the research questions:

- 1) Would the scores from selection test, an activity in the development of professional learning scheme, lead to identification of mastery of difficult topics among the group of teachers?
- 2) Would the activities (teachers' lesson preparation and delivery) within the scheme enhance pre-lesson preparation among teachers?
- 3) How correlated were the scores of selection test with the teaching skill of the teachers?

Scope of the Study

This study developed a professional learning scheme to improve teachers' teaching competence. The study was restricted to the identified difficult topics by WAEC Chief Examiners report and was restricted to a particular term where most of these identified topics were taught. It was further restricted to Abeokuta North and South Local Government Areas of Ogun State, Nigeria.

Significance of the Study

The outcome of this research with respect to the independent variable (professional learning scheme) on dependent variables (assessment of teachers' competence) would form the basis to regularly organise training and retraining workshop for mathematics teachers in secondary schools, especially on difficult topics which some teachers skip because of little or no knowledge of those topics.

METHODOLOGY

Research design

A descriptive survey research type was adopted for the work.

O_1 X_1 O_2 = Experimental Group I

O_1 X_2 O_2 = Experimental Group II

O_1 O_2 = Control Group

Where:

O_1 = Represents pre-observation on teaching skill that was administered to teachers who were exposed to the development of professional learning scheme.

O_2 = Post observation teaching skills

X_1 = Treatment I (Professional Learning Scheme and Enhanced supportive Skill)

X_2 = Treatment II (Professional Learning Scheme)

USG = Unsupported Group

Variables of the study: The following variables were used in the study:

Independent Variables: Treatment operated at three levels

- i. Professional Learning Scheme and Enhanced Supportive Skill (PLS + ESS)
- ii. Professional Learning Scheme (PLS ONLY)
 - i. Unsupported Group (USG)

Dependent Variable: Teachers' competence in teaching identified difficult topics in Mathematics.

Population

The target population comprised all the Senior Secondary School One (SSSI) students and their teachers in all the public Secondary Schools in Abeokuta Metropolis comprising of Abeokuta North and Abeokuta South Local Government Areas of Ogun State.

Sample and sampling procedure

The samples, consisting of 30 teachers and 1,610 students, were selected using the multistage sampling procedure. Abeokuta metropolis was clustered along the two Local Government Areas, i.e. the Abeokuta North and Abeokuta South Local Government Areas. Simple random sampling technique was used to select fifteen schools from each Local Government Area. The selected schools were randomly assigned to treatments and control groups. From the treatment groups, all the teachers teaching mathematics and their students in SSSI were selected. The computers (video recorded instruction) were used to disseminate teaching instructions in Experimental Group I Schools (those with Enhanced Supportive Skill) which served as motivators to enhance their understanding and interest in the topic.

Instrumentation

Teachers' Competence Observational Tool was adopted by the researcher to obtain information about the teachers' assessment competence and instructional delivery. It had two sections: Section A contained information on the school, such as name of the school, class, school's location, number of students, teacher's name, teacher's gender, and teacher's qualification, while Section B had information on the teacher's preparation, presentation and development of the content, instructional delivery, lesson development strategy, classroom organization and assessment method of the teacher. For the purpose of this study, both the face and content validity of the instrument were carried out on the instruments. To ensure face validity of the instruments, the initial drafts of the instruments were given to a group of

specialists in mathematics. Content validity was ensured by giving the instrument to lecturers who were experts in questionnaire construction. For the instrument, Cronbach Alpha was used to determine the reliability indices of the questionnaire.

The inter-rated reliability for each section of the instrument was obtained as follows Lesson Preparation Skill 0.958, Instruction Material 0.606, Pedagogical Skill 0.710, Assessment Skill 0.66 and Communication and Management Skill 0.79. The reliability of behavioural categories for 47 items was 0.728.

Experimental Groups

Professional Learning Scheme with Enhanced Supportive Skill

1. The group received the learning scheme with enhanced supportive skill.
2. The tool for the enhanced supportive skill was a recorded video teaching of identified difficult topics (construction, trigonometric ratio, mensuration, graph and logical reasoning). The video was produced and presented by the National Director of Workshop, Mathematical Association of Nigeria, Mr. Martin E. Ukwu.
3. Discussion of each topic was coordinated by the teacher identified to be good in the topic. The best performing teacher in the mastery selection test for a topic was identified to be good in the topic.

Experimental Group II: Professional Learning Scheme only

1. This group received only the learning scheme, but without enhanced supportive tools.
2. The group brainstormed on different methods of solving problems in identified difficult topics.
3. A teacher found to be good through the selection test in a topic was appointed to lead the discussion on that particular topic.

Unsupported Group

Participating teachers in this group taught the topics using the existing conventional methods. They did not participate in the intervention programme. They were equally subjected to Teachers' Observation Rating Scale.

Data analysis procedure

Descriptive analysis and Pearson Product Moment Correlation were used to answer the research questions raised in the study. Analysis of covariance (ANCOVA) was also used to test the hypotheses at 0.05 level of significance using the pre-treatment assessment scores as covariates. Any main effect observed to be significant was subjected to Sidak Post hoc test to determine the magnitude and direction of the effect and to ascertain the amount of variation due to each dependent variable.

RESULTS

Research Question 1

Would the scores from selection test, an activity in the development of professional learning scheme, lead to identification of mastery of difficult topics among the group of teachers?

Table 1 presents the result on pattern of teachers' performance in different aspects of Mathematics. The scores obtained were subjected to percentile rank in the succession of 25 percentile, 50 percentile and 75 percentile and was used to classify the scores into the high, moderate and low. The scores obtained from different aspects of mathematics with respect to the professional group was cross tabulated and presented in the Table 1.

Research Question 2

Will the activities within the scheme enhance pre-lesson preparation among teachers?

Table 2 presents the result on the influence of professional learning scheme on teachers' lesson preparation and delivery. The result reveals that mean teachers' competence or skills when teaching difficult topics increases or at least doubles after the training on professional learning scheme when compared with their initial competence level. The result further reveals that majority of the teachers were relatively good in the areas of pedagogical (PLS + ESS: Mean = 53.33, SD = 8.14; PLS ONLY: Mean = 52.20, SD = 7.32; USG: Mean = 25.33, SD = 13.12) and assessment (PLS + ESS: Mean = 50.73, SD = 5.83; PLS ONLY: Mean = 50.80, SD = 5.29; USG: Mean = 26.77, SD = 19.65) than other aspects of competency after the training activities.

Research Question 3

How correlated are the scores of selection test with the teaching skill of the teachers?

Table 3 shows the inter-correlation between teachers' competency or teaching skills and selection scores for those teachers that engaged in professional learning scheme training. The result reveals that before the training the selection scores has relationship with teachers' assessment skills ($r=0.45$, $p<0.05$). It could be observed from the result that selection scores could only determine the magnitude of teachers' assessment. The result further reveals that the training selection score has significant positive relationship with teachers usage of instructional materials ($r=0.43$, $p<0.05$), pedagogical skills ($r=0.418$, $p<0.05$) as well as assessment skills ($r=0.35$, $p<0.05$).

Table 1: Pattern of Teachers' Scores in Identified Difficult Topics in Mathematics

Topic	Group	Low	Moderate	High
Construction	A	5	10	0
	B	8	7	0
	Total	13	17	0
Trigonometric	A	4	4	7
	B	7	3	5
	Total	11	7	12
Mensuration	A	7	5	3
	B	11	4	0
	Total	18	9	3
Logical Reason	A	7	5	3
	B	11	4	0
	Total	18	9	3

Table 2: Change in Teachers' Lesson Preparation and Delivery Before and After Engagement in Professional Learning Scheme Training

Skills	Grp-A (PLS + ESS)				Grp-B (PLS)				Grp-C (USG)			
	Pre-test	Std. Dev.	Post-Test	Std. Dev.	Pre-test	Std. Dev.	Post-Test	Std. Dev.	Pre-test	Std. Dev.	Post-Test	Std. Dev.
Lesson Preparation	9.13	2.50	21.93	3.17	8.10	1.37	22.40	1.65	9.0	2.06	10.55	3.64

Instruction Material Improvisation	8.80	2.01	22.46	5.48	8.70	1.83	24.90	4.38	9.30	2.39	10.66	4.03
Pedagogical	20.93	7.38	53.33	8.14	19.70	4.62	52.20	7.32	22.11	4.01	25.33	13.12
Assessment	21.53	7.89	50.73	5.96	18.10	3.48	50.80	5.29	21.0	2.82	26.77	19.65
Communication	8.33	3.039	17.33	2.09	6.90	1.45	17.30	2.16	8.11	1.90	7.33	3.04
Management	13.26	5.22	25.60	6.64	10.80	2.11	29.10	3.67	12.44	1.42	12.44	1.42

Key: PLS + ESS = Professional Learning Scheme with Enhanced Supportive Skill, PLS ONLY = Professional Learning Scheme alone, USG = Unsupported Group

Table 3: Inter-correlation Matrix between Teachers' Teaching Skills (Before and After) and Selection Score for the Engagement in Professional Learning Scheme Training

	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	Score
A1	1												
A2	.22	1											
A3	.411*	.353*	1										
A4	.25	.25	.29	1									
A5	.396*	.30	.26	.699**	1								
A6	.28	.33	.364*	.757**	.842**	1							
B1	-.17	-.14	-.18	-.21	-.30	-.25	1						
B2	-.10	.01	-.29	.00	-.11	-.15	.822**	1					
B3	-.21	-.04	-.26	-.01	-.09	-.08	.879**	.894**	1				
B4	-.30	-.07	-.28	-.05	-.15	-.16	.840**	.825**	.921**	1			
B5	-.22	-.11	-.10	.00	-.05	.02	.830**	.736**	.828**	.80**	1		
B6	-.357*	.04	-.27	-.21	-.33	-.30	.780**	.785**	.807**	.78**	.743**	1	
Score	.21	.06	.24	.45**	.31	.33	.29	.43*	.418*	.35*	.32	.08	1

Key: A1= Pre-Lesson Prep. A2= Pre-Instructional Material Usage, A3= Pre-Pedagogical skill, A4= Pre-Assessment Skills, A5=Pre-communication Skills, A6=Class Mgt. Skills, B1=Post-Lesson Prep. B2=Pre-Instructional Material Usage, B3= Post Pedagogy Skills, B4=Post Assessment Skill, B5=Post Communication Skills, B6= Post-Class Mgt. Skill.

DISCUSSION

From the result, it could be observed that majority of the teachers' sampled especially those in group A were within 50 percentile in construction aspect of the topics which showed that they performed moderately. Scores from trigonometric aspect of the topics reveals that most teachers especially those in group A were in the rank of 75 percentile which was an indication that they scored high in that aspect. It could also be observed that the teachers scored low in the areas of mensuration and logical reasoning in favour of group B, as their scores were within 25 percentile. This implies that most teachers have little mastery of such topics as Logical Reasoning and Mensuration, have good mastery of Trigonometric but were trying to catch up with Construction.

Quite a number of the teachers currently teaching in secondary schools were not trained in the field. They were not graduates of mathematics, but were rather compelled to teach mathematics due to few hands of available graduates of mathematics. It therefore followed that there was a tendency to skip any topic the untrained teachers were not good at,

which became detrimental to the students. Many studies showed that students learn more from teachers with strong academic skills than they do from teachers with weak academic skills (Meroni, Vera-Toscano and Costa, 2015; Tichovolsky, Kupersmidt, Voegler-Lee and Arnold, 2015). The findings were so consistent on the agreement that teachers' academic skills were linked to students learning (Blazar and Kraft, 2017; Popoola and Adeaga, 2008). Mensuration and construction have to do with skills and it is therefore not surprising that teachers without the skills could not possibly pass the skills to the students. The training revealed that the teachers did not possess skills in using some mathematical instruments to teach students

Most of the teachers in Group A have the required qualification in mathematics that made them suitable for teaching the subject. This is evident in the higher number of teachers in Group A that were WAEC examiners with only few (3 out of 16 participants) that were examiners in Group B. Hill, Charalambos and Chin (2018) found a significant positive correlation between the professional subject-matter qualification of a teacher and his understanding of topics in the subject. Teachers with professional qualification in mathematics understand better the various topics in the curricula of Ordinary Level mathematics than teachers with professional qualification in other science subjects apart from mathematics.

The West African Examinations Council (WAEC) Chief Examiners' Reports (2015, 2018) emphasized the importance of engaging subject-matter specialists in the teaching of their subjects of specialization. All of the 18 teachers in Group A were, at the time of the research, participating actively in the marking sessions organized by both WAEC and NECO. Only three of the sixteen teachers in Group B were examiners of the two examination bodies. A combination of teachers' subject-matter and opportunities of joint moderation and marking sessions gave the teachers in Group A better leverage in the understanding of the difficult topics than Group B teachers.

Also of importance in the understanding of results is the nature of the topic itself. In trigonometry, everything centers on right-angled triangles, a topic easily understood by learners. Students get introduced to the topic as early as JSS3. Trigonometry deals with only one shape. However, mensuration deals with diverse shapes of solid objects, with some being two-dimensional and some three-dimensional. Many untrained teachers lack the proper understanding of various shapes contained in Mensuration, hence they have little understanding of this area of mathematics.

Further results indicate that the activities within the professional learning scheme enhanced the pre-lesson preparation skill of the sampled teachers in various aspects of competence and could as well improve the competence of other teachers if they undergo such training. Skill acquisition and enhancement are generally the expected outcome of any programme that aims to develop any group of professionals. Improvements in pedagogical skill were observed during the interactive sessions among the teachers. Some teachers had the tendencies to stick to a particular method which might not give the students the understanding of the concept of the topic. In most cases, the teachers did not have better alternatives until this intervention began. The intervention gave the teachers alternative teaching method as used by someone else. Exposure to such new method had effect on the teachers' performances as observed in better teaching skill in the identified difficult topics. Professional development of teachers, through series of interactive sessions, had improved the achievement of the teachers. Darling-Hammond *et al.* (2017) and Reeves (2018) stated

that if teachers undergo professional development, their knowledge and skills are widened which are necessary ingredients for the students' success. A strong relationship existed between the teachers' exposure to training and skill development (Blazar and Kraft, 2017).

The study showed that the selection scores could determine to some extent the teaching skills of the teachers and help select those that would coordinate the teaching of the various identified difficult topics. The selection test covered each of the identified difficult topics and was administered before the commencement training. It served to know the level of the base knowledge of the teachers in each topic. The concept was not different from pre- and post-test administration. Ödalen, Brommesson, Erlingsson, Schaffer and Fogelgren (2019) stressed the importance of selection test while training university teachers to become better teachers. The selection test provided a way of knowing the starting point of knowledge and awareness in the subject of training, and where it was well planned, it could give an indication of what to expect, the level of difficulties and challenges the organisers would face in the training programme. In this study, the selection test allowed a careful selection of teachers with adequate knowledge of the areas of interest who could serve as demonstrators to others in those specific areas where they have demonstrated comparative advantage.

CONCLUSION

It is established in this study that teachers' competence in handling the identified difficult topics in ordinary level mathematics could be enhanced by exposing the teachers to a Professional Learning Scheme (PLS) with and without Enhanced Supportive Scheme (ESS). These treatments (PLS ONLY and PLS + ESS) had led to increase in teachers' competence in handling such topics as construction, mensuration, trigonometry, graphs and logical reasoning. The study also found that PLS ONLY was more effective in the overall improvement of teachers' competence.

RECOMMENDATIONS

The following are the recommendations for the various stakeholders in the field of education:

1. The two treatments – PLS ONLY and PLS + ESS significantly improved teachers' competence in the identified difficult topics in mathematics. Any of the two treatments could therefore be recommended for improving teachers' competence.
2. In terms of complexity and cost implication, PLS ONLY is a better option. It is less cumbersome as there is no additional enhancement provided. It involves the provision of the Professional Learning Scheme only. It also yields better teachers' competence. In this respect, PLS ONLY is recommended for implementation by the government and other interested non-governmental organization who wish to improve the students' achievement in mathematics.
3. Having seen the positive impact of the Scheme on the teachers' competence and bearing in mind that the government cannot provide all that is required to sustain such a Scheme, the Mathematical Association of Nigeria, M. A. N. could support the Federal and State Governments in organizing such Professional Learning Scheme Workshop regularly in different states of the country for the practicing mathematics teachers.
4. Upon the completion of the field work, the participating teachers express their desires to continue the interaction at their own expense. They are desirous to come together as a group – the Professional Learning Group. It is therefore recommended that the

Professional Learning Scheme be transformed to Professional Learning Group with membership in all the schools in the state and in the nation.

5. For an all-encompassing and broadly effective Scheme, the prototype study here could be extended to all levels of primary and secondary schools. This way, a more solid foundation will be ensured that will generate the much-desired educational improvement in our nation.

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