RE-TRAINING FOR PRODUCTION OF QUALITY SECONDARY SCHOOL MATHEMATICS TEACHERS IN CROSS RIVER STATE

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Abstract
Quality teacher production is paramount in any educational system for improved learning outcomes. The purpose of this study is to determine if the re-training of teachers of mathematics through workshops and the like enhance the quality and competence of the teachers. The study is a quasi-experimental pre-test and post-test in design. The sample size of 27 mathematics teachers randomly selected from government-owned secondary schools for a re-training workshop was involved in the study. They were re-trained in the area of linear inequalities in one and two variables, quadratic inequalities and their graphs. A teacher-made eight-item essay type Mathematics Achievement Test (MAT) instrument that was face validated by three mathematics educators and one expert in measurement and evaluation was used for the study and administered to the teachers before and after the training. The hypothesis tested at 0.05 level of significance and 26 degrees of freedom with a dependent t-statistics was a non significance difference between the mean scores of the secondary school teachers of mathematics before and after re-training. There was a significance difference in the mean achievement score of the teachers leading to the rejection of the null hypothesis and acceptance of the alternative hypothesis. Based on the result of the findings, conclusions were drawn and suggestions made for a way for improvement.

Teacher production programme faces a series of challenges, teachers in training may have poor knowledge of the subjects they are expected to teach, especially where the status of teaching is low and the educational standards of entrants to teacher preparation courses are poor. Therefore the re-training of teachers of mathematics is one area of teacher production that needs a deserved attention in the Nigerian educational system. In Nigeria, the demand for mathematics teachers substantially exceeds the supply due to factors such as mathematics teacher preparation system, and perceived unattractive conditions of service. Many mathematics teachers are ill-prepared to meet the demands posed by the changing and challenging nature of their jobs. At the secondary school level, teachers specialize in particular subject areas such as mathematics, physics, biology, etc. Because of the level and complexity of the courses to be learnt in mathematics teacher programme and preparation, there are always a limited number of individuals opting to offer mathematics. However, to bridge the gap between the required number of mathematics teachers and those willing to study mathematics, some unwilling would be teachers are compulsorily re-directed to offer mathematics at the tertiary level of their teacher preparation. The result of which is the production of not so well motivated and prepared teachers of mathematics. Looking at this scenario, it becomes imperative and clear that the re-training of mathematics teachers can raise teachers’ performance levels and prepare the individuals for change and challenges in the teaching job. According to Swanepoel and Erasmus(2000), teacher re-training should result in the following:

i. improve the standard and performance of teachers, once their training needs have been identified;
ii. prepare the teachers for future positions
iii. increase their literacy levels; competencies and skills
iv. help them to make better decisions and increase job satisfaction.

The purpose of re-training mathematics teachers therefore, includes to update, develop and broaden the knowledge they acquired during the initial teacher education, and provide them with new skills and professional understanding. Even if they received a quality initial teacher education,
mathematics teachers need to be trained their whole life. Musset (2010) has it that continuing training is even more important in countries where teachers do not have all the academic preparation they should have and that such exposure is a great tool to develop the skills needed to reach higher student performance and outcomes.

Conco (2005) has also opined that the end result of teacher re-training should be informed and creative teachers who promote academic transformation and education renewal. UNESCO (1996) is of the view that skills and competencies of many teachers who have received pre-service training are inadequate and that pre-service training in some teacher education institutions is of low standard. Nwagbara (2013) posited that teachers have not kept pace with the rapid growth knowledge, particularly in science, technology and mathematics, hence, their knowledge and skill in these subjects need to be upgraded. UNESCO(1993) in summary has it that teacher in-service training in science, technology and mathematics (STM) is needed to upgrade teachers’ competencies and skill, update teachers’ knowledge in these subjects, enable teachers to implement new curricula; and to familiarize teachers with new methods and approaches to teaching STM. Musset (2010) however stressed that the re-training activities can be very heterogeneous and vary from dissemination conferences, workshops, (preparation to new subject-matter content), school based activities (study groups, courses) to personal teacher development(individual activities outside of schools).

The most commonly used approach to teacher re-training in Nigeria is the one-time workshop of 5 days per year, which according to Musset (2010) is ineffective and inefficient. In despite of the great potentials of re-training, there seems to be a general discontent among teachers. Musset (2010) has emphasized on teachers’ complaints as to the workshops being too fragmented, lacking intensity and unrelated to teaching practices. It therefore means that designs for teachers re-training especially in mathematics should be context-specific, and modeled in function of specific needs. This, therefore, calls for a coherence between the re-training received by teachers and what actually happens in classrooms, building into the re-training effort a systematic quality mechanism.

Re-training for quality teacher production is a sine-qua-non for the advancement of education in Nigeria. The difficulties encountered by both teachers and students in the teaching and learning of mathematics calls for a sincere and honest teacher preparation that is a continuum and life-long experience beginning from initial teacher education to retirement. The several essential stages that compose quality teacher education have to be intrinsically connected. Musset (2010) has noted that the initial education that teachers receive constitutes a solid base of the knowledge and skills that they will need for their task, and retraining allows them to update this “patrimony” and to adapt it to the changes of the teaching environment. Nwagbara (2013) has asserted that the coherence of initial teacher training and education and professional development through re-training in mathematics has to be improved since the articulation of the different elements is fundamental and undoubtedly there are synergies between them that influence what and how to teach mathematics. Chamberlin (1999), Czub (1999), Edmund (2001), Mothatha (2000) Robb (2000) have all recognized that teacher re-training engenders empowerment, changing of skills and attitudes, improvement level of competence, capacitation, improvement of skills on job performed, self reliance and dignity. Nwagbara (2013) also identified that teacher development through re-training strengthens the capacity of the educational system to perform its mission more effectively and efficiently and also provides for the growth of the national human resources.

Teaching is a complex endeavour, involving classroom management, lesson preparation and organization of teaching and learning activities, creating and maintaining a certain climate, and evaluation and feedback. Principles of effective teaching are hinged on supportive classroom climate, opportunity to learn, curricular alignment, establishing learning orientations, coherent content, thoughtful discourse,
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practice and application activities, scaffolding students’ task engagement, strategy teaching, cooperative learning, goal oriented assessment and achievement expectations (Brophy, 2001). Teacher training and professional development of teachers through re-training, therefore, precede the ambitious task of providing teachers with rich teaching repertoires. Since student outcomes depend largely on teacher quality, government and stakeholders need to foster teachers’ continuous professional enhancement in order to cope effectively with ongoing changes and improve the quality of education. However, it is sad to note that in Nigeria most teacher re-training efforts even in the 21st century were based on a training paradigm which implied a deficit-mastery model and consisted of “one-shot” re-training and development approaches. Research on these programmes has provided evidence of the failure of such earlier concepts (Richardson and Placier, 2001; Clarke and Hollingsworth, 2002). These findings and increased criticism have provided an impetus for many rechargers to reconceptualize teachers’ re-training and professional development by taking a “change as professional growth or learning” perspective to teacher re-training. Inspired by adult learning theories and in congruence with situated cognitive perspectives on learning Anderson, et al, (2000); Clarke and Hollingsworth, (2002); Jarvis, (1987), Kwakman, (2003); Putman and Borko (2000); Symlie, (1995), teacher learning is seen as an active and constructive process that is problem-oriented and takes place throughout teachers’ lives. As a consequence, researchers have emphasized the notion of ongoing and lifelong professional learning embedded in school activities as a national and expected component of teachers’ professional activities and a key component of school improvement (Putman and Borko, 2000; Sleegers, Bochuis and Geijsel, 2005; Symlie and Hart, 1999).

In line with these perspectives, the focus of this study is to examine how re-training of mathematics teachers enhance their capacity and knowledge, skills and values, problem solving ability which will improve the service they provide to their clients (students) to achieve the set out objectives. The area of emphasis of this study is on linear and quadratic inequalities perceived by the researcher as challenging to practicing secondary school mathematics teachers.

Objective of the Study
The main objective of this study is to determine if re-training of secondary school mathematics teachers improved their subject content understanding, achievement and problem solving.

Research Question
Is there any significant improvement in subject content understanding, achievement and problem solving competencies of secondary school mathematics teachers through re-training?

Research Hypothesis
\( H_0: \) There is no significant difference in the mean achievement scores of secondary school mathematics teachers before and after re-training.
\( H_1: \) There is a significant difference in the mean achievement scores of secondary school mathematics teachers before and after re-training.

Population and Sample
The population of this study was made up of 78 teachers of mathematics in government owned secondary schools in Abi, Obubra and Yakurr Local Government Areas of Cross River State. The sample size was 27 teachers of mathematics that were randomly selected for re-training in a workshop organized by the Cross River State Ministry of Education in collaboration with Cross River State College of Education, Akamkpa.
Research Instrument

A researcher made mathematics achievement test (MAT) instrument was used for the study. It consisted of eight item essay type of questions with focus on the concept of inequalities and solving of problems therein. The test items covered linear inequality in one and two variables, quadratic inequalities, sketching of inequality graphs, sketches and interpretations of given problems. The test was given to the teachers before treatment as pre-test and at the end of treatment as post-test. They were instructed to answer all the questions within test period of one hour. The instructions were simple and easy to follow. The questions were framed in clear and comprehensible language divorced of ambiguity. A table of specification was used to ensure content validity. Item analysis was computed to find out the difficulty and discriminating indices. This helped in choosing which test items would be sustained, which ones would be replaced and which would be dropped. The instrument constructed by the researcher was given for face validation to three mathematics educators, one expert in measurement and evaluation for screening in terms of scope, clarity, and ambiguity. Due to their comments, and item analysis, some test items were restructured while some were changed to make for clearer understanding by the teachers. Reliability of the test instrument was achieved by administering the same test to some 18 mathematics teachers used for pilot study who were not involved in the experiment. Using the split half method, the two sets of test scores were correlated by use of the Karl Pearson product moment coefficient approach to obtain a yield of correlation coefficient of r=0.83 value which suggests a very high reliability and internal consistency rate.

Research Design and Data Collection

The study was a one-shot quasi-experimental type involving a pre-test and post-test of the respondents. The respondents were given the test before the teaching of the specified topics under normal test conditions. After teaching the respondents the topics for three days, the same test was administered on them as post-test. The two different test answer scripts of the experiment were marked by the researcher using a standardized marking guide to avoid variations in the scores of the respondents.

Data Analysis

The only hypothesis of the study was tested using the dependent t-statistics. The two sets of scores were also correlated to determine how close they associate by Karl Pearson’s product moment coefficient ratio.

Result

Table 1: Correlation Coefficient of the Pre-Test and Post-Test Score

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Σx</th>
<th>Σy</th>
<th>Σxy</th>
<th>Σx²</th>
<th>Σy²</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test score(x)</td>
<td>27</td>
<td>588</td>
<td></td>
<td></td>
<td>17,634</td>
<td></td>
<td>0.58</td>
</tr>
<tr>
<td>Post-test score(y)</td>
<td>27</td>
<td>919</td>
<td></td>
<td></td>
<td>22,939</td>
<td>36,475</td>
<td></td>
</tr>
</tbody>
</table>

Source: Field study

From Table 1, the correlation coefficient of r=0.58 showed a mild association between the pre-test and post-test scores. That is to say that the raw scores are not closely related to each other. The differences may be accounted for by the gain in scores as a result of the teaching and learning of the concepts to the teachers after the pre-test.
Table 2: Mean and Standard Deviation Scores of the Pre-Test and Post-Test Administered

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t_c</th>
<th>t_e</th>
<th>d_f</th>
<th>α-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test (x)</td>
<td>27</td>
<td>21.8</td>
<td>13.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-test (y)</td>
<td>27</td>
<td>34.0</td>
<td>13.9</td>
<td>2.39</td>
<td>2.06</td>
<td>26</td>
<td>0.05</td>
</tr>
<tr>
<td>Difference</td>
<td>12.2</td>
<td>0.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Field study

Table 2 depicts the difference in mean scores of the various tests which is (MTS) of 12.2 which shows a gain in scores after the pretest as a result of gain in achievement due to a better understanding of the concepts under study. There was also a gain difference in the standard deviation due to improvement and difference in the learning outcome of the teachers under consideration.

Hypothesis

There is no significant difference in the mean achievement scores of Secondary school Mathematics Teachers before and after re-training.

The details from Tables 1 and 2 show that the weak correlation and difference in the mean achievement score is significant. The calculated dependent t-score of 2.39 is greater than that of the table value of 2.06 at 0.05 level of significance and 26 degrees of freedom which is significant. The significance shows that the difference in mean achievement scores is not by chance. Thus, the null hypothesis is rejected and the alternative accepted. This implies that there is significant difference in the mean achievement scores of the teachers before and after the re-training on those mathematics topics. This implies that the teachers achieved more on the test after they have been taught those topics during the re-training sessions. A significant effect size of 56% is a pointer in the direction of achievement gains.

Conclusion and Recommendations

There has been a continual poor performance of students in mathematics at all levels over the years. There is also an observable loss of interest in mathematics by Nigerian students at all levels of education. There is the suspicion that the teachers’ level of competence in mathematics may have a contribution in the poor state of affairs since student outcomes depend greatly on teacher quality. Government and school managers need to foster teachers’ re-training to enhance professional competence in order to cope effectively with ongoing changes and improve the quality of education.

In view of the above, the study has to be undertaken to determine the impact of re-training of teachers of mathematics in some selected mathematics topics on the teachers’ learning achievement in the areas of mathematics. The study was a quasi-experimental pre-test and post-test type that elicited the gain in achievement after the teaching of topics on inequalities to the teachers that were involved in re-training workshop took part in the exercise. The null hypothesis of no significance difference was rejected and the alternative of significance was accepted. That is to say the re-training had impact on the teachers achievement. And conclusively the re-training of teachers of mathematics through workshops helps to improve in the production of quality teachers of mathematics in Cross River State.

Teaching mathematics for effective learning and application demands from the teachers an innovative inclination and high performance capable of giving rise to a knowledge-driven and knowledge-dependent society with ever-increasing high level competences and expertise necessary for national growth and prosperity. Mathematics learning and knowledge acquisition should encourage
transformative knowledge through discovery and extension, impartation, preservation, retrieval and application.

In teaching or teacher production, what is desirable is “the knowledge teacher with flexible and adaptable skills” re-training will lead to acquisition of skills, knowledge and techniques that are related to teacher requirements in the specific field of mathematics. The re-training exercise has to pass through the mathematics teachers as this is the only way the teachers will acquire from the programme the tangibles (certificates of participation, specific knowledge, which could be ephemeral) together with the intangibles (life-long and life-wide learning skills, an analytical and creative mind, intrapersonal and interpersonal skills) which are more enduring.

Quality teacher production re-training programme will entail total commitment to sustainable human development, knowledge generation, transfer, dissemination and application. The goal of in-service and retraining of mathematics teachers programme should be that at the end of their training, teachers are able to provide constructive and knowledgeable answers to the following questions in order to produce positive social and academic outcomes in their schools.

i. How can I teach basic mathematics skills in a conceptually rich way?
ii. How do I manage my classroom effectively and positively to achieve desired results?
iii. How do I motivate children to learn mathematics?
iv. How do I select appropriate materials and activities that are stimulating and interesting?

The new National Teacher Education Policy for pre-service and in-service (NTEP, 2009) has incorporated these domains of concern. In-service teacher education and re-training programmes in mathematics focusing on skills and competencies enhance teachers’ attitudes, skills and knowledge and the teachers are in a better position to more effectively meet the needs of children.

Mulkeen, et al (2007), have evidence that there is a positive correlation between teachers’ knowledge of their subjects and their impact in the classroom. Teachers’ lack of understanding of the principles of their subject may impede good teaching especially in subjects like mathematics. However, teachers may acquire the appropriate understanding through subject specific pedagogical re-training course more effectively than through higher academic qualifications in their subject (Wilson, et al 2001).

From the above, it is recommended that for quality production of teachers of mathematics; in-service and re-training of teachers of mathematics in secondary schools be strengthened by grouping of teachers working together to learn, share experiences, reflect upon and explore ways of improving their practices rather than large scale workshops that have little impact on the teachers’ practice.

One option of re-training and in-service teacher development that is cost reducing is the distance learning education since it permits mathematics teachers to continue to teach instead of taking them out of the classroom. E-learning and the Open University are highly recommended in this wise.

There could be involvement of experienced mathematics teachers in the design and delivery of courses at the school (or cluster of schools) level. This will ensure that the courses and topics are relevant and of practical use. Short interventions that show little sustainable change in classroom teaching should be discouraged as methods of re-training teachers of mathematics.

Where the re-training of mathematics teachers through a short and one-shot five-day workshop per year approach is continued, it would be advisable for the organizers and policy initiators to ensure that teachers that attend such workshops go back to their schools and localities to re-train other mathematics
teachers for efficiency and effectiveness. In this direction, the re-training will trickle down to a beneficial level in the communities and localities.

There should be year round follow-up programmes to monitor the teachers’ progress. Substantive knowledge, be it mathematical or otherwise is not learned overnight. Teachers need mathematical reinforcement over an extended period of time say (four days each month for a year). Let the teachers be observed in their own classrooms by experienced mathematics teachers to help find out if the re-trained teachers are successfully putting the new mathematical knowledge to work.

Motivation is an important aspect of learning. Teachers of mathematics should be handsomely paid for participating in in-service and re-training programmes. It has to be noted that the period for re-training cuts into their vacations and weekends and often take time away from a needed second income or interferes with family life. Unless they are paid to participate there will be no leverage to ask for their conscientious effort to learn.

In all ramifications, re-training of mathematics teachers through workshops, in-service exposure, distance and e-learning are desirable efforts geared in the right direction of high quality teacher production.

References


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