

THE AFRICAN REGIONAL RESEARCH SEMINAR

**University Interventions in improving the Teaching of Science and Mathematics in
Community Day Secondary Schools in Malawi : Assessment of the Impact**

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Presented at the Second African Regional UNESCO Forum Research Seminar held in
Accra, Ghana, March 22-24, 2007

INTRODUCTION

1.1 Community Day Secondary Schools (CDSSs) in Malawi face a critical shortage of qualified science and mathematics teachers. More than ninety percent of the teachers are only qualified to teach at primary school, resulting in extremely poor pass rates.

Mzuzu University has developed a teacher education programme that has been undertaken to improve the performance of a large number of science and mathematics teachers from these CDSSs at a very minimum cost, and shortest possible time, and yet expect to produce impact. In this programme, students, who are practising CDSS teachers, are admitted into Mzuzu University during the University's long vacation of twelve weeks.

This intervention is called the Secondary School Teacher Improvement Programme (SSTIP).

The aims of the programme are:

- To improve the academic competencies of Mathematics and Science teachers in CDSS, thereby strengthening their ability to apply knowledge and skills in teaching.
- To enable those who would do well in the programme to be eligible for entry into a diploma programme in a college of education.

1.2 Nations all over the world realize the important role played by science in development. One sustainable way of promoting science is through education.

In Malawi, the starting point of the education of most children is primary school. There are eight grades in primary school, after which students sit a national examination, the Primary School Leaving Certificate Examination (PSLCE). The results of this examination determine selection to secondary school, which is four years. At the end of the four years students take the Malawi School Certificate of Education Examination (MSCE), which is also a nation-wide examination. This serves as a school leaving examination for most students. The score determines eligibility for higher education and most jobs.

The challenges faced by the national education system of Malawi cannot be over-emphasized. The symptoms are obvious, with a high drop-out rate of 17% in primary school, low progression rate at secondary education at 18% and even lower progression rate to university with only 0.3% of the learners proceeding to University. This state of affairs has led to shortage of qualified professionals which also includes teachers.

When Malawi became a multiparty democracy in 1994, school fees for primary education was abolished. This resulted in an overwhelming increase in enrolment. The enrolment increased by 51% between 1993/94 and 1994/95 academic years, EMIS (1999) Government could not manage to build conventional type of secondary schools to take care of this sudden increase. The solution was to convert Distance Education Centres into Community Day Secondary Schools (CDSS). The majority of Secondary School-going students nationwide were admitted into these schools such that between 1993 and 1994 there was an increment of 100,000 students in such schools, and by 1999 CDSS students dominated enrolment, accounting to over half of the total national enrolment (EMIS,1999)

2. Context and Issue

CDSSs are schools that were originally Distance Education Centres (DECs). They used to be independent learning facilities without resources. They were built and run by communities or

communities just identified primary schools to be used in the afternoons. In those days, students followed correspondence materials. In December, 1998, the Government announced that all DEC's should be converted into CDSS's. Despite this, CDSS's have still remained dominated by very poor resources and poorly-qualified teachers. Apart from head-teachers and one or two teachers, the teachers who teach science and mathematics, and indeed all other subjects in these schools are under-qualified. The Ministry of Education in 1997 indicated that only 1% of teachers of the CDSS are qualified to teach at a secondary school. The academic qualification of such teachers is the School Leaving Certificate (equivalent to the English "O" Level), which is the same qualification their students qualify for. Professionally, they have only a Primary School Teaching Certificate qualification. Such teachers fail to qualify for entrance into the college of education, where they could upgrade.

As can be expected the pass rates in these schools is very low. Although the pass rate of the students in CDSS's is extremely low at only an average of 6% at the School Leaving Certificate,

Mzuzu University is the second national university in Malawi. In the eight years it has been operational, the university has established three faculties, the largest of which is the Faculty of Education.

The Faculty of Education offers mainly undergraduate programmes. By the end of 2006 the faculty had produced 353 graduate secondary school teachers, 131 with Bachelor of Science (with Education) degrees and 222 with Bachelor of Arts (with Education) degrees. This output is still a far cry from the teacher shortage registered.

The Intervention Process

a. A needs assessment was carried out to determine the areas in which the teachers need the most help. Teachers identified specific topics in Mathematics, Physical Science and Biology that they found difficult to teach.

The research team concluded that the teaching problems arise not only from poor teaching methodologies, but also from lack of knowledge of subject matter.

b. A tailor – made curriculum was developed for the programme. It was developed to meet the following objectives:

- To include science and mathematics content which is at a level that is slightly higher than the level they themselves teach. This level can be likened to the “O-A” level of the British Educational System. The content should also include the problem areas identified.
- To teach methodology courses whose emphasis is on student-centred approaches without confining the teaching to the laboratory. This means emphasizing activities like Directed Activities Related to Text (DARTS), using the environment and using the concept of TALULAR (teaching and learning using locally available resources).
- To emphasize cooperative learning – Cooperative learning has been shown by Novak (1994) to empower learners to lead themselves through course content and materials. This is useful to ensure that the students can continue the question for knowledge after the short course period.
- To use continuous assessment to assess the so as to evaluate a large number of capabilities, skills and areas of the content

A summary of the curriculum is shown in the appendix.

c. Selection of students: Students are selected based on the criteria that in their MSCE, they have passes in mathematics, and another pass in either biology or physical science. Other requirements are that students should be teaching the subjects they would study and that they should be CDSS teachers of not more than 45 years of age. In addition, the Ministry of Education ensures that there is equal representation from the different Education Divisions of the country

d. At the end of the twelve-week programme the teacher learners sit examinations that are equivalent to a University bridging course examination, so that those who pass that examination can be considered ready for admission into university.

Data was collected through observer notes taken in classes, interviews with lecturers and school heads, from test results, and questionnaires. Questionnaires were administered to former teacher learners, and heads of department of the schools where the teacher learners work.

The examination scores of all the 678 from the three cohorts of 2004, 2005 and 2006 were used. These scores were computed to find out the pass rate of the students the core subjects. Although academic scores are not a clear indication of students' future professional development, they are still an indication of achievement. For in-depth study, the performance of the third cohort of the biology group was closely monitored and their continuous assessment grades were computed. This was done in order to assess how their performance was being affected by the learning process. The biology group was used because the researcher had most access to them since she was one of their lecturers. Lecturers from each subject area were interviewed. They provided information on students' levels of capabilities and how they were coping with the course.

Qualitative data was gathered using survey questionnaires. One questionnaire sought information from thirty randomly selected former students. The items required them to determine the impact of the course on their teaching performance. Another questionnaire was administered to heads of science departments of the randomly selected schools in which the former students were teaching. The items requested information that determines the impact of the course on the teachers' performance in their actual teaching.

4.2 Key Findings

Currently, the programme has enrolled its fourth cohort and so far, the number of teacher learners that have graduated are shown in table 1.

Table 1: Number of Students Enrolled

Cohort	Total Number Enrolled	P/Sc Option	Biology Option
1 (2004)	182	55	127
2 (2005)	196	91	104
3 (2006)	300	83	217

What are the capability levels of the teacher-learners on admission to the Teacher Improvement Programme?

Lecturers indicated that when they were being admitted into the course, students had the most difficulties in the following areas: (in descending order of the most commonly mentioned)

- Knowledge: At the start of the course the learners' knowledge was narrow. It was evident they had not been able to read beyond the basic recommended school texts.
- Scientific method: Most learners had difficulty grasping the basic concepts which are used in developing science through research. Even when the teachers showed that they had understood the meaning of a hypothesis they failed to differentiate between different kinds of variables when carrying out a written exercise.
Teaching Methodology: Nearly all students were unfamiliar with the syllabuses for both junior and senior school courses. However on introduction to these syllabuses for the first time they showed enthusiastic appreciation of the general objectives, subject goals.
- Language: They made many errors in spelling, grammar and pronunciation. They had some difficulty in understanding spoken and written English.

Deficiency in English was apparent with students having great difficulty in understanding questions and applying knowledge.

- In the practical session the students had difficulty in manipulating equipment like microscopes.

What are the expectations of the teacher-learners from the Teacher Improvement course?

In-order to find out what the learners expectations were, the questionnaire included items that required them to indicate their expectations and say whether they felt their expectations had been met. Table 2 gives the responses.

Table 2: Students Expectations from the programme
n = 30

Expectation	% response	Whether Met	%
To qualify for a diploma or degree course	50	Not met	60
		Partially met	40
		Fully met	0
To learn better methods of teaching	20	Not met	0
		Partially met	50
		Fully met	50
To acquire mastery of content	20	Not met	0
		Partially met	0
		Fully met	100
To earn a salary raise	10	Not met	100
		Partially met	0
		Fully met	0
To acquire a higher qualification	10	Not met	0
		Partially met	0
		Fully met	100

To optimize learning, it becomes necessary for educators to understand students’ needs and expectations for a course of study, and as Matiru et. al. (1993) indicates, a mismatch between the learner and the content or approach to the teaching of a subject will reduce learning outcomes. From the findings of this study it looks like there is a slight mismatch between the students’ expectations and what the course designers planned. The majority of the students expect to use their admission into the university to get a recognizable qualification such as a diploma or degree whilst the course was designed mostly to improve the teaching competencies of a big number of teachers.

What is the impact of the Teacher improvement course on the academic competencies of the teacher learners?

The achievement of the teacher learners was measured by different assessment procedures. At the end of the course, an end- of course examination was administered. This , together with the continuous assessment grade, gave the overall grade for the learner. Figures 1, 2,and 3 are computed scores of the learners in the three cohorts in the various core subjects:

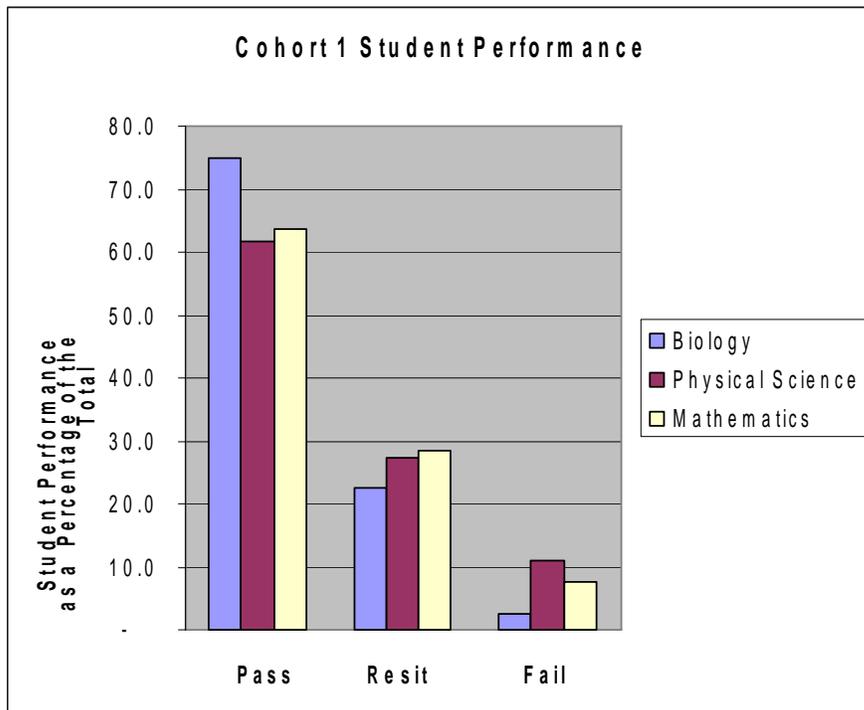


Fig. 1: Performance of students in the First Cohort of 2004

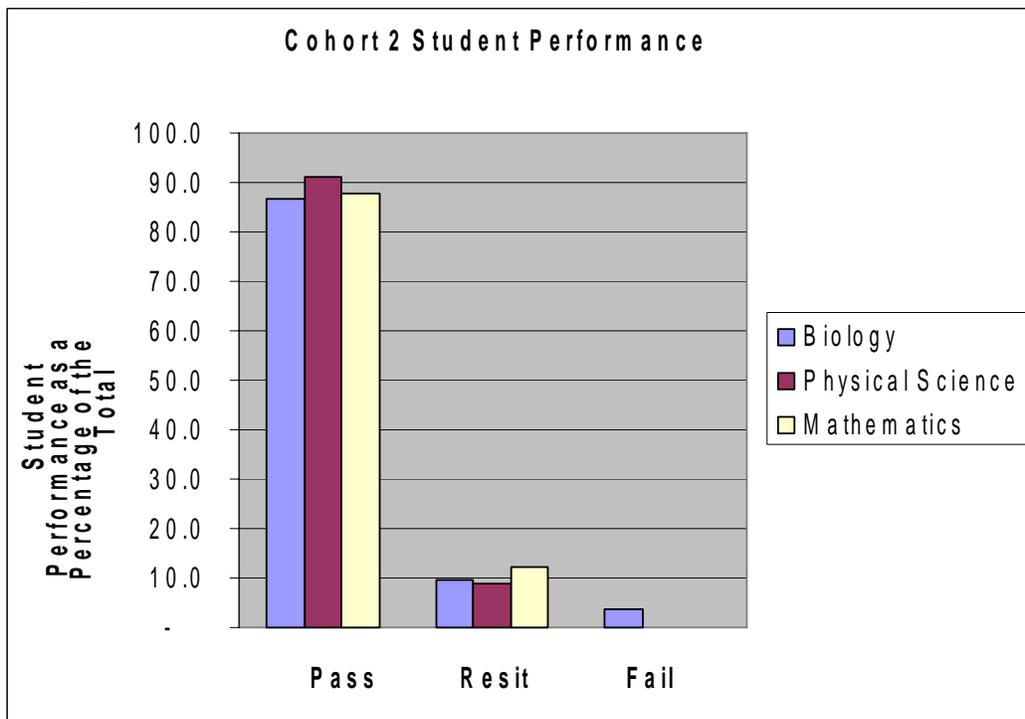


Fig 2: Performance of students in the Second Cohort of 2005

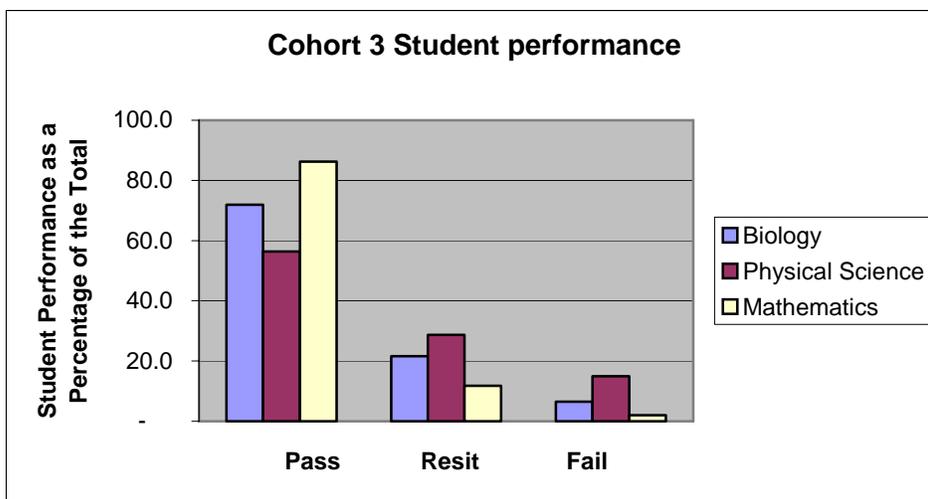
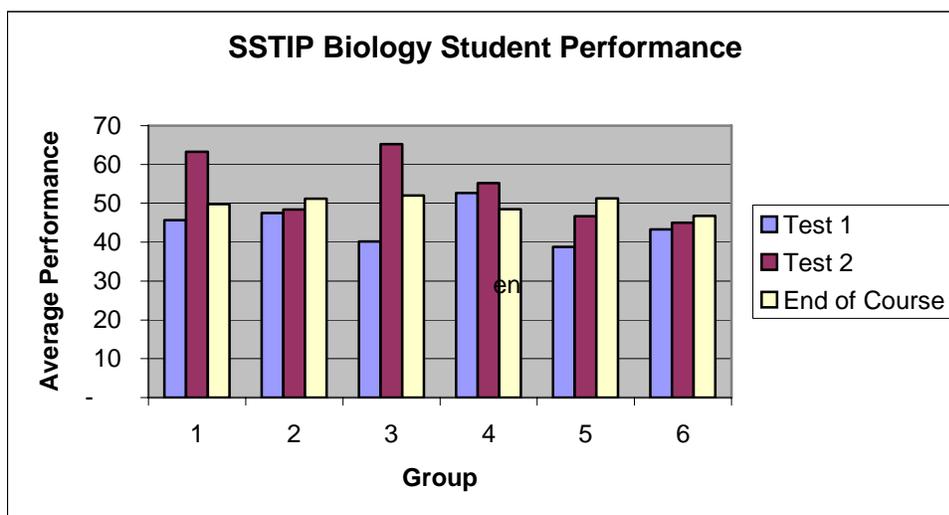


Fig 3: Performance of students in the Third Cohort of 2006

These scores show that the second cohort results were better than cohort one or cohort three results. A number of factors could account for this. Lecturers have indicated that the experience of teaching the first cohort made them realise that the students had weak education backgrounds. The realisation made many rethink their teaching strategies. It is likely that selection affected cohort three performances. Since each cohort selected those with better grades by the time cohort three was being selected the average entrance grade had declined.



The scores show that there is a continuous improvement in the academic performance of the teacher-learners. This indicates that given the right learning environment and resources, most of these teachers are trainable, the majority of them indicated that they had their secondary education in CDSSs also, showing that they have weak educational backgrounds.

- **Are there any noticeable changes in the pedagogical skills of the teacher learners after the course?**

When heads of departments were asked to indicate which areas the teaches-learners had improved most in, they gave the responses shown in table 3.

Table 3: Rating of Pedagogical Skills of the teacher-learners

Skill category	% Response
Confidence in teaching	67
More use of pupil-centred teaching methods	33
Ability to effectively deliver content	88

The findings show that there have been noticeable changes in pedagogical skills of the teachers, especially in their use of pupil-centred methodologies and their confidence in handling content and in doing experiments and field work. Through classroom discussions there was an indication that the teachers were aware of the strengths in using pupil-centred teaching. However they believed that these teaching strategies were only appropriate for primary school. They felt secondary school students appreciate more “serious” teaching methods like lecture and other passive techniques.

- **How do the students rate their achievement from the programme ?**

When students were asked to indicate how they rated their performance in various skills, they gave responses as indicated in table 4.

Table 4: Students rating of their achievement in various skills/specialist areas

Skills	Rating of their degree of Improvement				
	Excellent	Very Good	Good	Satisfactory	Unsatisfactory
Teaching Methodologies	33	50	17	0	0
Use of instructional media		50	50	0	0
Mastery of content knowledge	67	33	0	0	0
Degree of confidence	67	33	0	0	0
Resourcefulness	17	67	17	0	0
Degree of Professionalism	50	50	0	0	0

The indication by students that they feel confident about mastering content may be helpful to them. When all is said and done, teaching is still about imparting knowledge. This, combined with a higher sense of confidence could bring a difference to the schools.

5. Recommendations

5.1 We can see that interventions like these can play a big role in helping to raise standards of science and mathematics in schools. Government should make it policy that these unqualified

teachers should undergo short-term upgrading courses like the one described in this study before they undertake their teaching posts in secondary schools.

The University should show the Government the impact of even such short-term interventions.

5.2 Plans for Action

Government should take up the challenge of sponsoring upgrading courses like the one described in this study to these unqualified teachers before they undertake their teaching posts in secondary schools. The University or the College of Education can develop the curriculum and train the teachers annually during their vacations.

6.0 Operational Aspects

6.1 Resources

Universities and colleges that already train secondary school teachers have both the human resources and the facilities to undertake such programmes. During their long vacations most of their facilities are available for use.

6.2 Preliminary Evaluation

When teacher's content knowledge of the subject is extremely low and their method of teaching very traditionally authoritarian, a short spell of exposure to a higher-level of thinking with hands-on experience of progressive teaching methods can have a dramatic effect. By improving the knowledge and pedagogical skills of a few very weak teachers in many schools, pupils in a wide area benefit from teachers with a broader understanding of their subject and the ability to inspire them.

However such an intervention needs careful curriculum design with clear aims, objectives and well planned activities and methods of delivery. As found in the Mzuzu University initiative, these may need refining and reviewing after the first attempts.

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Appendix
Curriculum

Alternative	Subject Combinations	Number of Hours/Week	
		Subject	Total
1 (Biology Option)	<ul style="list-style-type: none"> • Biology • Mathematics • Communication Studies • Education and Teaching • Biology and Mathematics methodology 	6 10 3 4 3	26
2 (Physical Science Option)	<ul style="list-style-type: none"> • Physics • Chemistry • Mathematics • Communication Studies • Education and Teaching Studies • Physical Science and Mathematics methodology 	5 5 10 3 4 2	29