

Exploring the Impact of Mentoring In-service Teachers Enrolled in a Mathematics, Science and Technology Education Programme

Doras Sibanda
Kavish Jawahar

Abstract

The Advanced Certificate in Education programme in Mathematics, Science and Technology (MST ACE) offered by the University of KwaZulu-Natal was a collaborative effort between the university and the national Department of Education. The programme was originally offered by the university with classroom support provided to in-service teachers in the general education and training phase. The programme aimed to improve the subject content knowledge and teaching skills of teachers. One innovation of the programme was the inclusion of classroom based mentoring. This paper explores the impact of classroom-based support as offered in the programme on the development of in-service teachers. Data was collected through programme evaluation questionnaires, written submissions from in-service teachers and school visit mentors. Our results show that both in-service teachers and school visit tutors were supportive of the inclusion of the school visit support component of the MST ACE programme. The findings of the study will contribute to a nuanced understanding of the need for classroom support for in-service teachers' programmes and provides an empirical basis for further curriculum innovation as well as academic monitoring and support.

Keywords: innovation, mentoring, school visits, in-service teachers, school visit mentors, development, general education and training

Introduction

The concept of mentoring dates back 2000 years to Homer, who described the goddess Athena in his poem, *The Iliad*, as a mentor to Odysseus' son

Telemachus. A mentor in ancient times was viewed as a teacher or guardian (Subtonik *et al.* 2010). Despite the historical origins of the term mentoring, there is currently no agreed definition of mentoring. A modern definition of mentoring often involves a long-term commitment by mentors to support mentees. Thus mentoring does not only rely on role modelling, but involves intellectual and emotional support (Jacobi 1991). Wang and Odell (2002) identified a variety of qualities needed in mentoring, for example, essential aspects include supporting the development of effective classroom practice. Mentoring for the purpose of this paper is defined as an appointment of competent teachers with experience to undertake the supervision of novice teachers during teaching practice in schools (Wilkin 1992).

There are different ways of running mentoring programme. For example, some mentoring programmes run by schools and higher education institutions (HEI) focus on short-term role modelling designed to motivate and inspire learners (Subotnik *et al.* 2010). The mentoring of in-service teachers reported in this paper takes the form of role modelling where school visit mentors were able to assist in-service teachers with lesson planning and the actual teaching of the lesson.

Mentoring in pre-service has been included in all teacher development programmes and usually takes the form of a partnership between the higher education institution and the school. For this paper, the higher education institution views the mentoring partnership as an important tool for promoting learning of pre-service, novice and in-service teachers. We examine the mentoring partnership by focusing on the relationship between school visit mentors (representing the HEI) and in-service teachers. The individuals chosen to be visiting mentors were tasked with helping in-service who registered for MST ACE programme. The mentoring relationship, it was assumed, would improve their teaching skills in general and in teaching the mathematics, science and technology subjects in particular. In other words, the mentors' role at school, in alignment with the ACE-MST programme, was to develop the in-service teachers' content knowledge and teaching skills.

The reflections of the in-service teachers and school visit mentors gave an indication of the value of the school visits to teacher development programmes such as the MST ACE programme. consequently, the importance of this study can be traced to issues of context: first, the geographical spread of the in-service teachers and second, the schools where

in-service teachers were based did not have experienced teachers in the mathematics, science and technology (MST) specialisations. It transpired then that the effectiveness of mentoring of in-service (MST) was dependent on the quality of the mentors and this paper provides insight into the ways and limits of the mentoring approach used.

Background to the Roles of School Visit Mentors

The Third International Mathematics and Science Study (TIMSS) in 1994/1995 and TIMSS-R (repeat survey, 1999) found that South African learners were weak in mathematics and science at grade 8 level compared with other learners internationally. One of the factors identified as a contributor to the poor performance of learners was the lack of competent teachers. In trying to address this problem, the national Department of Education and the University of KwaZulu-Natal decided to offer an in-service programme to provide school visit support to teachers in order to improve their teaching skills and subject knowledge in MST subjects. A budget was built into the programme to allow the university to purchase and supply General Education Training (GET) science, mathematics and technology kits to in-service teachers to support their daily teaching at school.

Conceptualising the school visit aspect of the MST ACE programme provided two major challenges; firstly, most of the in-service teachers were employed in schools which were situated a considerable distance from the university thus reducing the viability of university staff visits to supervise and mentor the students. Secondly, the large number of students in the cohort would not have allowed for the relatively small number of staff involved in the programme to conduct the school visits themselves. The alternative was to request the schools at which the students worked to nominate a mentor from the school to provide teaching practice support. This route was not however possible because there are few qualified and experienced mathematics, science and technology teachers in the UMzinyathi District in KwaZulu-Natal. As a result, retired educators with expertise in the teaching of MST subjects were identified and recruited as school visit mentors. School visit mentors were trained on how to conduct school visits, use of the observation schedules and how to give constructive feedback.

The mentors' roles were to provide guidance on how to plan a lesson and to demonstrate use of the science kits provided in the programme. The mentors in this programme did not conform to the role of the mentors as identified in the literature; hence the concept 'school visit mentors'. These mentors were able to provide classroom support to in-service teachers on a short term basis. For example, the mentor helped with lesson planning and provided a written record of how the lesson was taught and of the suggestions made to improve their teaching practices. Each mentor also completed an overall evaluation of the teaching practice support component of the UKZN MST ACE programme at the end of the school visit period. An overall evaluation was also completed by in-service teachers at the end of the programme.

Review of Literature on Mentoring

A review of the literature on mentoring from 1990 to 2007 carried out by Crisp and Cruz (2009) revealed that there were at least 50 definitions of mentoring. For example, some researchers have used the term mentoring to describe the role of mentors (Watson 1999) and others have defined mentoring as a concept (Roberts 2000). According to Feiman-Nemser (2003), mentoring should be linked to a goal of good teaching that promotes teacher learning. This means that mentors should provide support to mentees on their teaching and make sure that teachers develop during the process.

There are several studies on mentoring; for example Fischer and Van Andel (2002) looked at two-way professional development between mentor and mentee during the mentoring process. When looking at mentoring in-service teachers and issues of role diversity, Halai (2006) found that both mentors and mentees perceived subject knowledge expertise as a significant aspect of the mentors' role. The mentors suggested that there was a need to expose teachers to new ideas, new knowledge and understanding to foster growth through reflection. There was also a need for collaborative interaction between mentors and mentees to promote learning by both parties.

Most studies on mentoring focus on the relationship between the mentor and the mentee (Hawkey 1998). A minority of studies focus on students' experience of mentoring and their contribution in the mentoring

process (Zanting *et al.* 2001). Richards (2010), underscores the importance of mentors in professional development of new teachers.

The role of on mentoring of pre-service and in-service teachers undertaking a professional qualification is well understood in the literature. However, the role of mentoring teaching practice for in-service teachers is not very clear. For example, Edwards (1998) identifies the roles of school-based teachers' mentors and university tutors. One of the primary roles of mentors is to give feedback to mentees on their teaching. However, there is little documentation on the mentors' role in the context of in-service teacher development (Halai 2006).

Fricke (2008) studied mentoring programmes of in-service teachers, such as the Teacher Mentoring Programme. This programme focused on mediating problematic areas and promoting the classroom practice of teachers. Mentors were used to support individual teachers at schools. The programme was aimed at assisting mathematics and science teachers in order to promote the matriculation pass rate and motivate learners to take up science-related careers. The programme provided support to teachers by holding winter schools and teachers attended upgrading courses at higher education institution. Although this programme studied mentoring of in-service teachers, the type of support provided in that programme is different to the one reported in this paper.

From the literature it is clear that there is little or no research on in-service teachers' mentoring. There is, however ample evidence that many studies on mentoring focused on pre-service teachers. This study fills the gap by contributing to the literature on the effectiveness of mentoring in-services teachers in critical subjects such as mathematics, science and technology in the general education and training phase. A unique aspect of mentoring illustrated in this paper is that the school visit mentors assumed both the roles routinely undertaken by the school-based mentor and of university lecturers.

Theoretical Framework

Most studies on mentoring have focused on models on mentoring. For example, Maynard and Furlong (1993) view mentoring as occurring in stages, such as apprenticeship, competency and reflection. The apprentice model takes place at the beginning of teaching practice when the trainee teacher

works closely with the mentor and the mentor acts as a model and assists the trainees to understand the teaching process. The competence model is the second phase of stage of the teaching practice. At this stage the, mentor assumes the role of trainer and engages the trainer in a more organised training programme that includes observation of lessons and begins to give feedback on agreed outcomes. The reflective model is the final stage of teaching practice and at this stage the mentor take the role of co-enquirer in order to encourage a more critical reflection of the teaching and learning of the trainees .At the reflection stage the mentor encourages the trainee teacher to reflect on his/her teaching and learning.

Similarly, McIntyre and Hagger (1993) have identified three version of mentoring mentors based on the expertise offered by the mentors. They view mentoring as consisting of minimal, developed and extended versions. In the minimal version of mentoring, provide basic supervision to mentees to develop their knowledge and skills. Whilst in the developed version of mentoring, mentors help mentees to reflect on their ideas and practice and at this stage the mentors share their expertise with mentees and give advice on the issues pertaining to the teaching process. At the last stage, the extended version of mentoring, the mentees' learning is extended to include the issues involving whole school and the community.

The effect of each model on mentoring is likely to produce different results. This study takes the version of the mentoring that is based on the expertise of mentors as suggested by McIntyre and Hagger (1993) as a lens to mediate the findings.

Methodology

A qualitative research approach was used to analyse the reflections of in-service teachers, school visit mentors, and academic coordinators regarding the relevance and efficacy of the school visit mentoring support programme. The participants for the study were in-service teachers enrolled in the MST ACE programme, school visit mentors and university coordinators of the programme. The selection of multiple groups of participants was essential to validate the findings and to get a wider perspective of mentoring as an approach in the MST ACE programme. The methods used to collect data include a questionnaire, written submissions from both the in-service teachers

and the mentors and classroom observation schedules. In this paper, the focus is largely on the data derived from in-service teachers and school visit mentors.

The in-service participants were registered in the Advanced Certificate in Education. In-service teachers provided a convenient sample and they volunteered their participation in the study. The number of in-service teachers in the study numbered 163. During this period, in-service teachers were observed teaching once per semester and four times over the entire period. Each in-service teacher was visited four times by the same school visit mentor. The reflections of in-service teacher participants were rich sources of data.

The questionnaire was administered to in-service participants over a period of 2 years. A total of 163 students responded to this questionnaire. The questions solicited their opinions about the running of the general programme, learning materials, tutorial sessions, assessment, learning outcomes, and communication technology and lesson observations. In this paper only data on questions focusing of lesson observations will be analysed and reported on. The students were asked to respond to positively phrased statements using a five-point Likert scale where A meant strongly agree, B agree, C neutral, D disagree, and E strongly agree.

The participation of mentors in the study was to get their perspectives on the development of in-service teachers. The idea was not to discredit or validate data from in-service teachers, but to provide another layer of interpretation to infer the impact of the mentoring aspect of the MST ACE programme. We asked the six participating mentors to comment on the students' performance during classroom observation. The mentors had to write their observations twice for the duration of the programme, one at the end of the second visit and an overall comment at the end of the fourth visit.

The analysis proceeded as follows: firstly, in order to obtain a mean, each response category was awarded a numerical value, for example. 1 for strongly disagree and 5 for strongly agree. Secondly, categories with A & B values were aggregated to mean a positive response and categories with D & E were aggregated to mean a negative response.

The data was captured on Excel computer software and the written comments from in-service teachers were captured in a word document and exported to in vivo for analysis.

Results

The paper seeks to address the following research question: What was the impact of the school visit mentoring support in the 2008-2010 MST ACE programmes on in-service teachers' development? The answer is framed by two categories, namely, the significance of school-based mentoring, and learning provided by school visit mentoring. We discuss each in turn.

The Significance of School-based Mentoring

Table 1 describes in-service teachers' responses to the three statements concerning the impact of school based mentoring. There was a consistent agreement about the importance of the programme and there were also some in-service teachers who were not satisfied with the programme.

Table 1. In-service teachers' responses to the questions on developmental aspects of school visits on their teaching

Item	Question	Number of Respondents				Mean
		Total	% positive	% Neutral	% negative	
I	I have a greater awareness of approaches to teaching mathematics, science and technology as a result of the feedback from the school visit mentors	160	90	5	5	4.2
II	I am able to use a greater variety of teaching strategies in my own classroom as a result of feedback from school mentors	160	93	5	3	4.3
II	I found that my teaching practice in the classroom improved as a result of feedback from the school visit mentors	160	90	7	3	4.3

The results in Table 1 indicate that more 90% of the in-service teachers were positive about the feedback they received from the school visit mentors and were aware of their teaching approaches and that their teaching had improved. Only a small percentage (10%) of the in-service teachers said that they did not benefit from the school visit mentoring. In general the results indicate that the in-service teachers said that their teaching improved because of their participation in the MST ACE school visit mentoring programme.

In the questionnaire, in-service teachers were required to comment on their experiences of the school visit and the feedback they received from the mentors. Only 102 in-service teachers wrote comments about school visits. The written comments were analysed and certain categories identified. These were developmental, learning, and negative comments. These categories were coded on nodes in In Vivo which was used to group similar comments.

The results indicate that out of the 102 in-service teachers who made comments, 40 in-service teachers reported that mentoring had helped them to improve their teaching and 26 said that they learnt something from the mentors. The analysis of written comments concerning the impact of school visits showed that in-service teachers felt school visits were strongly linked to personal development. The following data excerpts illustrate what the in-service teachers said about the developmental aspects of the MST ACE programme.

- I improved my teaching style, I networked with other teachers. They help a lot where I lacked knowledge; I learned that I have to plan for the grades before my class and for the grades after my class.
- The school visit mentors encouraged me to improve my teaching and I try to use more resources while teaching a lesson.
- The school visits were useful and constructive; they made me prepare my lesson thoroughly; as a result I learnt new approaches and information.
- The school visits were very useful to us; made us to have self-confidence as our mentors gave guidance.
- The school visits helped me a lot especially in improving my style in teaching and how to organize my work when preparing my lesson.

In the quotes in-service teachers said that the school based mentoring improved their teaching in many ways: they improved their approach to teaching through the use of more resources, enriched content and improved lesson preparation. Apart from directly improving content knowledge and pedagogical knowledge, they acquired knowledge of classroom preparation, lesson planning, and organisational skills. One can infer that mentoring in this instance provided more than that envisaged in the MST ACE programme as it enhanced and equipped the basic knowledge and skills we assume in-service teachers have.

From the perspective of mentors the following excerpts are instructive:

- Some of the students taught well and others satisfactory as they involved learners in practical work of the lesson to give more clarity whether they did not understand the lessons, some even brought objects in the classroom to drive the point home. For example bicycle was brought in class for teaching gears. There was some improvement since some of them did not involve learners in their teaching.
- The students taught well, they prepared well. The students made some improvements; they did not repeat the same mistake observed previously. The second visit was different from the first one.

The rest of the mentors had comments similar to these. The mentors seem kept records of the teacher's teaching practices and were able to notice changes in students' teaching during the two school visits. Whilst most of the in-service teachers felt they benefitted from the mentors support, the mentors were able to identify the range of the impact, from satisfactory to teaching well, and making 'some improvements'. The mentors were modest and restrained about the gains made by in-service teachers from their mentorship. However, the examples they gave of how resources were used to enhance teaching is evidence that supports the assertions made by in-service teachers. It is important to note too, that mistakes were not repeated, meaning that learning had taken place.

In the second report, the school visit mentors were requested to comment on the development of the in-service teachers for the period of the

mentorship. Table 2 is a summary of the mentors' comments after the fourth visit. The written reports from six mentors show that mentors noticed an improvement in how the in-service teachers conducted lessons. All six mentors said that they noticed an improvement in the manner in which the in-services teachers conducted their lessons. For example, one of the mentors indicated that some teachers did not involve learners from observations made during the first school visit. This changed as in the second visit there was a definite involvement of learners in the lesson. This means that there was a noticeable movement towards a learner-centred approach to teaching.

Table 2. Mentors' responses to in-service teachers' development indicators

Mentor	General comments about the school visits
1	Improved – teachers did not repeat previous mistakes. The second visit was different from the first visit
2	Improvement noticed. Pleasing to note
3	Improvement, result of being mentored. Positive change was noticed after first visit
4	Improvement in change of teaching method, style, approach to lesson development
5	Improvement, some initially couldn't involve learners in the lesson
6	Improved due to mentoring – the presence of the external person observing the lesson boosted morale to teach professional development. Regular contact between educator and mentor

Learning Provided by School Visit Mentoring

Concerning the learning aspects of the MST ACE programme, the following quotes illustrate what the teachers said:

- My mentor clarifies everything and he also answered my questions concerning my teaching, including the new curriculum.
- The visits have made me gain more knowledge and made me more confident when teaching because I was advised on how to improve on my areas of weakness.
- My mentor was good; he also discussed the findings after lesson observation and also helped me in many things. He praised me if I do well on how I presented the lesson in an interesting way.

- He motivated us and showed us how to involve learners in the learning area.
- The school visits from the mentors were helpful and the input from the mentor has developed me as a teacher and the way I approach some of the learning areas and teaching the lesson.
- The school visits were helpful. I did get a lot of information.

In the quotes it can be seen that teachers said they learnt from the mentors, their knowledge base had improved, and they learnt how to involve learners in class activities. Mentorship was experienced as beneficial as it motivated the teachers to become competent professionals.

In an attempt to understand the levels of learning and improvement of the in-service teachers' in their teaching of the MST subjects, we asked mentor to make the final decision by awarding the in-service teachers a grade during the fourth visit. The analysis of the school visit schedule shows that most of the in-service teachers improved their teaching and they were awarded a pass mark for their teaching experience. In table 3 a summary of the grades awarded by the mentors to in-service teachers are presented.

Table 3. Summary of teaching practice grades for MST ACE programme in-service teachers

Grades	No of in-service teachers	Percentages
Pass with distinction	30	15
Pass	144	72
Supplementary	2	1
Not stated	25	12
Total	201	100

The results indicate that 15% of the in-service teachers passed with a distinction. This figure is impressive considering that a majority of these teachers teach in poor, rural schools.

Although , the results from the both in service teachers and mentors indicate that the programme did help teachers to develop by learning from the mentors, there were a few in-service teachers who had negative feeling about the programme and the following quotes illustrate what they said,

- They must visit the school before the examination and we are visited in the learning areas we are not teaching.
- We need to be informed about the visits in time.
- They are useful and I think three visits are enough.

The data revealed that the in-service teachers disenchantment were mainly about their rights to be informed about the schedule of visits. More importantly, they were dissatisfied that the mentors did not come when they were teaching MST subjects, indicating that they valued input for these high stakes subjects. It seems too that some of them felt that a fourth visit was not necessary. We inferred that because in-service teachers are state employees there may have felt the need to demonstrate that they were quick learners with limited need of mentoring. They may have also misconstrued the mentoring relationship as an assessment of their abilities rather than professional development.

Discussion of Results

There is little doubt that the MST ACE school visit mentoring programme enhanced in-service teachers' teaching skills in MST subjects. The development of a teacher is always mediated by the mentor's experiences (Subotnik *et al.* 2010). The role played by the school visit mentors in the development of in-service teachers through reflection was critical to the success of the MST ACE programme. A number of positive issues emerged from mentors visits to the schools.

Considering the South African arena with its record of dismal results in key areas like mathematics science and reading, (see e.g. Bloch 2009), any programme that enhances professional learning has to be lauded. The improvement of in-service teachers' professional competencies means that many children in schools will be the beneficiaries of better teaching. It must be recognised, though, that the gains came about through mentoring relationships and partnerships with between schools and higher education institutions. The possibility exists for this particular mentoring approach (using school-based mentors) can be extended to subjects beyond mathematics, science and technology.

The data revealed that both visit mentors and in-service teachers perceived the MST ACE the school-based mentoring as important in the improvement of classroom practice. These findings are similar to those observed by Fricke (2008), where teachers said they benefited from the mentoring programmes. They also indicated that their subject content knowledge and confidence in teaching mathematics and physical science at the further education and training phase had improved. The importance of both pedagogical and content knowledge for good teaching outcomes has been emphasised by Shulman (1987), and the results from this study demonstrate that to be the case in this instance.

However, there were also some negatives expressed by participants that will need to be factored in to improve the outcomes of the MST ACE programme. First is the need to negotiate the visit schedule so that mentor and mentee know exactly when the visit will occur. There may also need to be flexibility built into the programme design to either reduce or increase the number of visits depending on the rate of development and confidence levels experienced by in-service teachers. There is a possibility that some of the in-service teachers could become school visit mentors in the future.

Implications of the Study

The school visit mentoring programme reported on in this study shows that in-service teachers developed competencies and skills from the programme and the mentorship relationships. There remains a concern about the silence in the data about the quality of the programme because of the lack of involvement of the subjects specialist from the university. We have a hunch that the mentor relationship is dominated by and overly dependent on practice with little integration of theory. This hunch will require further research.

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Doras Sibanda
Kavish Jawahar
School of Education
University of KwaZulu-Natal
Pietermaritzburg