Benchmarking Mentoring Practices for Effective Teaching of Mathematics and Science

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Pre-service mathematics and science teachers' perceptions of their mentoring experiences were investigated using the five factor model of mentoring practices as a lens through which mentoring practices can be benchmarked for improvement. The Mentoring for Effective Teaching instrument was used to collect data from 68 pre-service mathematics and science teachers on school placements in two Local Education Authorities (LEAs) in the South East region of England. The results of the data analysis indicate that mentors in the two LEAs overwhelmingly exhibit personal attributes for effective mentoring, provide adequate mentoring in pedagogical knowledge development, model effective teaching and professional practices and provide effective feedback to pre-service teachers. Yet, the results also indicate mentors did not provide adequate mentoring on systems requirements in relation to the national curriculum and school policies.

Keywords: Mentoring, Teacher Preparation, Pre-service Teachers

Introduction

Mentoring is thought to play a key role in the professional development and success of pre-service teachers on Initial Teacher Preparation (ITP) programmes. Hence it is used in ITP programmes throughout the world to support pre-service teachers on school placement (Mtetwa and Thompson 2000; Hobson et al. 2009). Yet, some pre-service teachers withdraw from ITP programmes either due to poor mentoring relationships or lack of success during school placement (Hobson, Giannakaki, and Chambers 2009). One way to improve on the quality of mentoring relationships is to evaluate mentors' practices at the end of school placement in order to provide feedback to mentors and mentors trainers.

Pre-service teachers' perceptions of their mentoring experiences have been studied using case study or other qualitative research methods (Hayes 2001; Hobson 2002; Maynard 2000). However, in England, there seems to be a dearth of large scale quantitative study of mentoring practices using a statistically validated survey instrument. This study aims to fill this gap in mentoring research in England and it is the initial phase of an intended large scale national survey of pre-service mathematics teachers. Such a study will enable much broader generalisations to be made about the mentoring experiences of pre-service mathematics teachers. Furthermore, it will provide benchmarks for comparing mentoring practices within ITP institutions.

The Five Factor Model of Mentoring

Hudson's (2004) five factor model of mentoring provides a framework for analysing mentors' personal attributes and mentoring practices. The five factor model identifies five categories of mentoring practices which were derived from the mentoring research literature. The five factors are: Personal Attributes, System Requirements, Pedagogical Knowledge, Modelling and Feedback. The model suggests that mentors need to exhibit personal attributes that enable them to support mentees by instilling positive attitudes and confidence in them, be encouraging, friendly, take keen interest in the work of the mentee and be able to listen attentively to the problems that the mentee may face during their school based training (Hudson 2004).

Hudson (2004) also argues that mentors need to articulate System Requirements, that is, school and national policies and curriculum documents, so that pre-service teachers can plan quality lessons and implement curriculum requirements and policies. Furthermore, Hudson (2004) appears to suggest that mentors must have good pedagogical knowledge and practices not only for teaching in their own classroom, but also in educating the mentee in both the subject content knowledge as well as the pedagogical practices. Mentoring practices associated with Pedagogical Knowledge can "focus on planning, timetabling, preparation, implementation, classroom management strategies, teaching strategies, [mathematics] teaching knowledge, questioning skills, problem solving strategies and assessment techniques in [secondary mathematics] education context" (Hudson 2004). Effective modelling involves the mentor displaying enthusiasm for teaching the subject. It involves the mentor using effective hands-on activities, good classroom management strategies and having good rapport with students.

Feedback is an essential element in the mentoring process (Hudson 2004). Feedback may involve pedagogical discourse prior to and after the delivery of a lesson. The provision of constructive feedback has the potential to instil confidence in the mentee and requires the mentor to employ the personal attributes and characteristics that support the mentee's emotional and psychological wellbeing.

Using factor analysis, Hudson (2005) developed the Mentoring for Effective Primary Science Teaching (MEPST) instrument which was subsequently adapted to develop the Mentoring for Effective Mathematics Teaching Instrument (MEMT) (Hudson, 2007). Both instruments were used to evaluate mentor attributes and practices in Australia. Since then, the instruments had been adapted and employed in analysing mentoring practices in teacher education in two other countries, Turkey (Hudson, Usak, and Savran-Gencer 2009) and Vietnam (Hudson, Nguyen, and Hudson 2008). In Turkey, the instrument was used to analyse mentoring practices in primary science teaching while in Vietnam it was used to analyse mentoring practices in English teaching. In these two countries the instruments were found to be valid and reliable in evaluating mentors' attributes and practices for effective teaching practices.

Aim and Objectives

The aim of the current study was to evaluate the mentoring practices in two Local Education Authorities (LEAs) in the South East region of England. The evaluation was undertaken by replicating Hudson's (2007) study using secondary pre-service teachers as participants. Hudson's study was replicated in order to ascertain the efficacy of the MEPST and MEMT instruments in a different cultural and educational context such as England. The research questions for the study were:

What effective personal attributes and mentoring practices are perceived to be exhibited by the mentors of pre-service mathematics and science teachers during their school placement?

Are there differences between pre-service teachers of different gender, age groups or placement location in relation to the perceived effective personal attributes and mentoring practices of their mentors?

To what extent do mentors model effective use of ICT during school placement?

Methodology

109 pre-service teachers following the postgraduate certificate in education (PGCE) programme in two LEAs were approached at the end of a lecture and asked to volunteer to take part in the study. Of the 109 pre-service teachers, 74 responded by filling in a paper based questionnaire or an online version giving a response rate of 68%. However, only 68 pre-service mathematics and science teachers completed the questionnaires fully. The MEPST and MEMT instruments were adapted as Mentoring for Effective Teaching (MET) instrument. The questionnaire had three sections. Section 1 had 34 likert scale type items with responses items ranging from strongly disagree, disagree, uncertain, agree and strongly agree. Section 1 also had three open–ended questions which were aimed at obtaining responses which could not be captured by the likert scale items. Section 2 had ten items that collected the demographic data bout pre-service teachers. Section 3 had ten items that collected demographic data about participants' mentors. The data was analysed in SPSS using descriptive statistics and ANOVA to ascertain any differences between groups including age, gender, and placement location. This paper discusses the results of the data analysis relating to the first research question; differences between pre-service mathematics and science teachers in relation to their mentoring experiences.

Results and discussion

The five factors of mentoring attributes and practices were analysed separately for pre-service mathematics (n=38) and science teachers (n=30). Table 1 shows acceptable Cronbach alpha scores for the five factors in relation to the perception of the mentoring experiences of pre-service mathematics and science teachers. Although the Cronbach alpha score for System Requirements for pre-service mathematics teachers was lower than 0.7, the difference was considered insignificant to invalidate the results of the study. The results in Table 1 also shows that while pre-service mathematics teachers typically perceived their mentors to exhibit effective personal attributes (M=4.03, SD=0.66), pre-service science teachers indicated feedback (M=4.05, SD=0.77) as the commonly perceived mentoring practice.

Table 1 Five factors of mentoring

Five factors of mentoring	Mathematics (*n*=38, Females=20, Males=18) Mean Score	*SD*	Cronbach alpha	Science (*n*=30, Females=19, Males=11) Mean Score	*SD*	Cronbach alpha
Personal Attributes	4.03	0.66	0.89	3.97	0.90	0.93
Systems Requirements	3.25	0.79	0.67	3.14	0.92	0.79
Pedagogical Knowledge	3.69	0.74	0.93	3.76	0.80	0.91
Modeling	3.93	0.49	0.79	3.83	0.85	0.94
Feedback	3.73	0.66	0.86	4.05	0.77	0.87

Table 2 shows that more mathematics mentors (95%) were comfortable in talking about their subject than science mentors (90%). Similarly, more mathematics mentors appeared to instil confidence in pre-service teachers during their school based training than science mentors (60%). Nonetheless the results indicate that overall most mathematics and science mentors exhibit personal attributes that enable effective mentoring of pre-service teachers. In relation to systems requirements, table 2 also showed that more science mentors (60%) discuss policy documents with their pre-service teachers than mathematics mentors (53%). While slight more mathematics mentors than science mentors shared knowledge of the curriculum with their pre-service teachers, the results for both groups are below 40% (See Table 2).

More science mentors were found to exhibit effective Pedagogical Knowledge than mathematics mentors although the difference was small. For example, more science mentors (90%) were found to assist with timetabling than mathematics mentors (82%). Fifty-seven percent of science mentors were thought to discuss content knowledge with their pre-service teachers compared to 52% of mathematics mentors (52%). However, the difference between the percentage of science mentors (70%) who assisted with assessment and percentage of mathematics mentors (43%) was much bigger. This suggests that perhaps within the LEA in question, science mentors may be encouraged to share their mentoring practices with mathematics mentors during mentor training days.

In relation to modelling, the results from the data analysis also suggest that more mathematics mentors appear to display enthusiasm and used the language of the subject than science mentors. However, 80% of science mentors were thought to have well designed activities for use in their lessons compared to 61% of mathematics mentor.

In terms of feedback, overwhelming majority of mathematics mentors (90%) and science mentors (97%) were thought to provide feedback after lesson observation. Although the nature and form of feedback still needs investigating, it often relates to a lesson that the mentor may have formally or informally observed. Often this may be given orally or in written form. More than half of mathematics and science mentors did not review the lesson plans of their mentees before they were taught (see table 2). It is not clear whether mentors are not reviewing lesson plans given to them or pre-service teachers are not getting the lesson plans to the mentors for them to review. Interview data could have revealed the reasons behind this high percentage of mentors who did not review lesson plans. However, one reason may be time factor although good time management on the part of pre-service teachers should ensure mentors receive lesson plans in good time for review.

Table 2 Differences in Mathematics and Pre-service Teachers' Perception of Mentoring

Percentage of participants who agreed or strongly agreed	Mathematics (*n*=38, Females=20, Males=18)			Science (*n*=30, Females=19, Males=11)		
	%*	Mean Score	*SD*	%*	Mean Score	*SD*
Personal Attributes						
Comfortable in talking	95	4.39	0.68	90	4.43	1.04
Instilled confidence in me	66	3.61	0.92	63	3.50	1.08
System Requirements						
Discussed policies	53	3.37	0.82	60	3.43	1.04
Outline curriculum	**34**	3.03	1.15	**30**	2.87	1.20
Pedagogical Knowledge						
Assisted with timetable	82	4.13	0.99	90	4.30	0.75
Discussed content knowledge with me	**52**	3.29	0.98	**57**	3.23	1.17
Assisted with assessment	**43**	3.47	0.92	**70**	3.67	1.18
Modelling						
Displayed enthusiasm	95	4.24	0.54	77	3.83	1.02
Used subject knowledge	74	3.89	0.65	57	3.57	1.07
Had well designed activities	61	3.63	0.82	80	3.77	0.86
Feedback						
Observed me before feedback	90	4.18	0.80	97	4.63	0.56
Reviewed lesson plans	**42**	2.39	0.97	**36**	3.00	1.26

Conclusion

The results discussed above indicate that, overwhelmingly, mentors in the two LEAs have personal attributes and mentoring practices for effective teaching of mathematics and science. However, there are specific areas that need further professional development to ensure that variation in the quality of mentoring in partnership schools is minimised. Clearly, for the mentors in the two LEAs, an urgent action in the form of training is needed to develop mentors' practices in relation to an overt discussion of the national curriculum and school policies, training of pre-service teachers in content knowledge and assessment. Moreover, the review of lesson plans prior to their live delivery is essential in order to avoid the negative impact that inappropriate lessons may have on pupils especially. Both mathematics and science mentors will therefore benefit from an overt training programme that ensures that practices are as good as those related to the provision of feedback after lesson observation.

References

Hayes, D. 2001. The Impact of Mentoring and Tutoring on Student Primary Teachers' Achievements: a case sudy. *Mentoring & Tutoring: Partnership in Learning* 9, no.1: 5-21.

Hobson, A. J. 2002. Student Teachers' Perceptions of School-based Mentoring Initial Teacher Training (ITT). *Mentoring & Tutoring: Partnership in Learning* 10, no.1: 5-20.

Hobson, A. J, P. Ashby, A. Malderez, and P. D. Tomlinson. 2009. Mentoring beginning teachers : What we know and what we don't. *Teaching and Teacher Education* 25, no 1: 207-216.
Hobson, A. J., M. Giannakaki, and G. N. Chambers. 2009. Who withdraws from inititial teacher preparation programmes and why? *Educational and Research* 51, no 3: 321-340.
Hudson, P. 2004. Specific mentoring: A theory and model for developing primary science teaching practices. *European Journal of Teacher Education* 27, no 2: 139-146.
_________ 2007. Examining mentors' practices for enhancing pre-service teachers pedagogical development in mathematics and science. *Mentoring & Tutoring:Partnership in Learning* 15, no 2: 201-207.
Hudson, P., T. M. Nguyen, and S. Hudson. 2008. Mentoring Vietnamese pre-service teachers in EFL writing. In *Proceedings JALT2007 : The Japan Association for Language Teaching 33rd International Conference*, edited by K. Bradford-Watts. Tokyo, Japan.
Hudson, P., M. Usak, and A. Savran-Gencer. 2009. Employing the five-factor mentoring instrument:analysing mentoring practices for teaching primary science. *European Journal of Teacher Education* 32, no 1: 63-74.
Maynard, T. 2000. Learning to Teach or Learning to Manage Mentors? Experiences of school-based teacher training. *Mentoring & Tutoring: Partnership in Learning* 8, no 1: 18-30.
Mtetwa, D. J., and J. J. Thompson. 2000. The Dilemma of Mentoring in Mathematics Teaching: Implications for Teacher Preparation in Zimbabwe. *Journal of In-Service Education* 26, no 1: 139-152.