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The impact of quantitative results on teacher training practice: a caution

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My doctoral research is concerned with the mathematical knowledge of novice teachers. The current shortage of mathematics teachers in the UK has prompted the government to introduce ‘subject knowledge enhancement’ (SKE) courses (TDA 2010). These courses are offered to graduates from numerate disciplines to enable them to train as mathematics teachers without having a mathematics degree. The mathematical knowledge of these two groups of trainee teachers (mathematics graduates and SKE students) may therefore differ and impact upon my research. Conversely, since there is a lack of existing research into the implications of SKE courses on teacher knowledge, my research has the potential to impact upon future teacher training provision.

Two existing studies provide initial insight. At one university in England, Stevenson (2008) found no significant difference in final Post Graduate Certificate of Education (PGCE – teacher training course) grades between students who had taken an SKE course and the whole group. Further, a recently published evaluation of SKE courses commissioned by the Teaching Agency (Gibson et al., 2013) found that SKE students felt their subject knowledge was at a lower level than subject graduates yet more relevant to a school context. These findings together imply that SKE students may have compensatory knowledge which allows them to achieve similar final PGCE grades despite their mathematical knowledge being at a lower level. Indeed, since Shulman introduced ‘pedagogical content knowledge’ in his seminal paper (1986), researchers have recognised that teachers need to know *more* than the subject to be taught.

Refining Shulman’s ideas, researchers have defined ‘mathematical knowledge for teaching’ (MKT) as *“the mathematical knowledge that teachers need to carry out their work as teachers of mathematics”* (Ball et al., 2008, p.4). It includes ‘common content knowledge’ (CCK) which is mathematics knowledge any well-educated adult should know but also ‘specialised content knowledge’ (SCK) which is mathematical knowledge beyond that expected of a well-educated adult but not requiring knowledge of students or teaching. In order to test for MKT, a pool of multiple-choice questions (Learning Mathematics for Teaching 2007) have been developed and extensively validated.

This article seeks to understand how the knowledge of mathematics graduates and SKE students who are taking a PGCE course differs. To achieve this, empirical results from my doctoral research are presented. I administered a sample of the MKT questions to secondary mathematics PGCE students in England as a pre- and post-test (towards the beginning and end of their course). It was hypothesised that SKE students possess greater levels of MKT and would therefore perform better on the MKT questions than mathematics graduates. The remainder of this article reports on preliminary results from the pre-test. For further details, see Warburton (2013).

1,773 PGCE places were allocated[i] for the academic year 2012-13. Out of these, 239 students from 21 institutions responded to the pre-test (13.5%). Almost half of these (49%) took an SKE course prior to their PGCE.

The reliability of the pre-test was reasonable as measured by Cronbach's alpha (0.67). The psychometric properties of the MKT questions were analysed using a dichotomous Rasch model. The Rasch analysis determined that using the questions (which were developed in the USA) in England was appropriate and confirmed that the questions measure a single underlying construct. On the test, those who did not take an SKE course scored higher on average[ii] than those who had. This difference was significant (t=2.878, p=0.004, r=0.18).

At first glance, this seems to suggest that it is not MKT which compensates for SKE students' lower levels of mathematical content knowledge since at the commencement of the PGCE course, mathematics graduates perform significantly better on average. However, there are several considerations to be made. Firstly, since MKT includes CCK, it could be that the questions selected for this research happened to include more CCK questions than other aspects of MKT. Alternatively, levels of MKT may depend more on CCK than previously anticipated. Secondly, the questions may test for something else other than MKT. For example, being skilled at mathematical reasoning or 'mathematical modes of inquiry' (see Watson and Barton 2011) which are learnt during a mathematics degree but not necessarily on an SKE course could lead to greater success on the questions. Finally, the SKE and non-SKE groups may be too broadly defined to give meaningful results. This is because the different lengths (2 weeks to 9 months) of SKE courses and differences in course content (for example not all SKE courses include A-level topics, some courses include school placements) were not accounted for in this research. Further, whilst SKE courses were intended for graduates without mathematics degrees, the SKE group actually contained some mathematics graduates (who perhaps wanted to refresh their subject knowledge). Similarly, the non-SKE students did not necessarily have mathematics degrees.

These results demonstrate the caution that needs to be taken when interpreting results which have the potential to impact upon teacher training practice. Although quantitative results are often viewed as 'objective', interpretation of them is not.

Further work needs to be undertaken for this research. Since this study cannot claim that a student scoring more highly on the MKT questions implies they will be a better mathematics teacher, final PGCE results will be collected to determine whether scores on MKT questions are better at predicting PGCE success than degree results. Additionally, once post-test scores have been collated, it can be seen whether the PGCE course has narrowed the gap in scores between SKE and non-SKE PGCE students or whether a difference still remains.

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[i] Not all of these places were taken up.
[ii] The terms of use of the MKT items state that raw scores, including mean scores, cannot be reported so are omitted here.