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How much of what? An analysis of the espoused and enacted mathematics and English curricula for intermediate phase student teachers at five South African universities

Abstract

Regulatory bodies such as the Department of Higher Education and Training (DHET) provide a framework of formal criteria to be addressed by providers of initial teacher education (ITE) but these criteria can be interpreted in many different ways. The Initial Teacher Education Research Project (ITERP) has investigated the preparation of intermediate phase (grades 4 to 6) teachers of mathematics and English at five South African universities, selected as representative of the major 'types' of institutions offering ITE. In this article we draw on our analysis of data from this research to describe and discuss the courses in mathematics and English offered by each of the five universities to student teachers specialising in mathematics or English and to 'non-specialists'. We suggest that while there are examples of excellent curriculum design and implementation, none of the universities in the study is fully addressing the challenges of teaching and learning in diverse intermediate phase classrooms. While acknowledging that answering the question "how much of what?" is particularly complex in teacher education contexts in which some students enter university with an inadequate knowledge base from which to develop content and pedagogic knowledge in a number of disciplines and inter-disciplinary fields, we offer some curriculum suggestions for teacher educators to consider.

Keywords: *Initial teacher education, curriculum, mathematics for teaching, English for teaching, intermediate phase; diverse classrooms*

1. Introduction

Regulatory bodies such as the Department of Higher Education and Training (DHET) provide a framework of formal criteria to be addressed by providers of initial teacher education (ITE) but these criteria can be interpreted in many different ways. One phase of the Initial Teacher Education Research Project (ITERP) has investigated the preparation of intermediate phase (grades 4 to 6) teachers of mathematics and English at five South African universities and this research is the focus of our paper. Grades 4 to 6

form a critically important schooling phase in which the majority of learners in South Africa move from learning in their primary language to using English as the main language of learning and teaching (LoLT). In these grades, they are also expected to move from proficiency in arithmetic, based on counting, to proficiency in using more sophisticated mathematical tools.

We begin with an outline of the overall design of the ITERP and of the methodologies adopted for collecting and analysing data in the various phases of the project. This outline is followed by a presentation and discussion of data in response to the questions in the paper's title: how much of what is offered to intermediate phase student teachers who have chosen to specialise in English or in mathematics or who have chosen other subject specialisations at one of the five universities in the study. The paper concludes with responses to issues raised in the previous sections. We have chosen to refer to relevant literature within each section rather than to offer a separate literature review.

2. The initial teacher education research project

This five-year study (2012-2016) was initiated by JET Education Services and is being undertaken in collaboration with the Education Deans' Forum, the DHET and the Department of Basic Education. The study began with a review of the conceptions of teaching underpinning the B.Ed. and PGCE curricula at five universities broadly representative of the major 'types' of South African universities offering ITE and of the overall coherence of curriculum design in each teacher preparation programme. In 2012, when the study was designed, these five universities produced 49% of all Bachelor of Education (B.Ed.) and 61% of all Postgraduate Certificate in Education (PGCE) graduates in the country (DHET, 2013). As is the case for other papers and reports on the project to date, the universities are referred to as universities A to E.

Field researchers visited each university where they collected a range of artefacts such as course outlines, reading packs and assessment outlines to obtain data for the review. They interviewed members of the academic staff and subsequently transcribed the interviews and checked the accuracy of the transcripts with the interviewees. All of the field researchers, data analysts and members of the ITERP reference group have extensive experience in teacher education and teacher professional development in the university and NGO sectors. The initial review was followed by a detailed analysis of the espoused and enacted curricula for mathematics and English for students intending to teach in the intermediate phase (grades 4 to 6) (the focus of this paper). A survey across all 23 higher education institutions (HEIs) of ITE students in their final year of study (B.Ed. IV and PGCE) and in their first two years of work or further study after graduation was also done. Linked to this survey research are case studies of a small number of graduates with an IP specialisation as they begin their careers in teaching.

The data collected for the initial review and for the in-depth analysis of mathematics and English curricula related to the B.Ed. curriculum were in use in 2013. Since then universities have been redesigning curricula to align with the minimum requirements for teacher education qualifications (MRTEQ) to which we refer in the concluding section of the paper, as our findings have implications for this curriculum redesign.

It should be noted that despite the best efforts of the field researchers, there are some gaps in the data sets and that because of the differences across universities in the design and teaching of B.Ed. curricula, analysis of the data has been a considerable challenge. For

example, some institutions integrate aspects of pedagogic content with subject content in the same course while others do not. Also, in the same institution this integration is evident in some courses but not in others. A further challenge is that some institutions offer year-long courses, while others offer semester-length modules, with the length of a semester varying from one institution to another. The relationship between course content and course credits also appears to vary within and across institutions. All of these variations add to the complexity of any comparative analysis and to the tentativeness of findings from the study. While acknowledging that our findings are not definitive, we hope that what is presented and discussed below will stimulate curriculum conversations among teacher educators engaged in initial teacher education.

3. The weighting of mathematics and English courses in the B.Ed. degree

While students at each of the five universities could choose the school subjects in which they wished to specialise, some courses in subjects in which they did not specialise were also a compulsory part of their degree programme. For ease of reference, we have labelled the students in the study as either specialists or non-specialists in mathematics or English. Table 1 summarises the total number of credits for all English courses offered to English specialists and non-specialists and all mathematics courses offered to mathematics specialists and non-specialists. These include courses where the focus is on disciplinary knowledge and courses with a focus on the teaching and learning of the related subject at school and for English, courses in academic literacy.

Table 1: Number of English and mathematics credits and proportion of credits (%) in the B.Ed. degree for the intermediate phase

University	A	B	C	D	E
English courses for IP English specialists	120 (25%)	162 (31%)	72 (15%)	120 (24%)	Home Language: 72 (15%) First Additional Language: 34 (7%-11%) Academic Literacy: credits not specified
English courses for IP English non-specialists	30 (6%)	28 (5%)	36 (7.5%)	24 (5%)	Home Language: 28 (6%) First Additional Language: 29 (6%) Academic Literacy: credits not specified
Mathematics courses for IP mathematics specialists	100 (21%)	128 (25%)	108 (23%)	120 (24%)	64 (13%)

University	A	B	C	D	E
Mathematics courses for IP mathematics non-specialists	40 (8%)	16 (3%)	12 (2.5%)	68 (13%)	19 (4%)

With reference to the curricular question 'how much?', the variation across universities is striking, with English courses for specialist English teachers constituting only 15% of the overall degree at university C, while the comparable figure for university B is 31%. Similarly, mathematics courses for specialists vary from 13% of the degree programme at university E to 25% at university B. The very limited formal exposure of non-specialists to courses in English and mathematics is a cause for concern given that many IP teachers are likely to teach one or both of these subjects during their teaching careers. Furthermore, it is concerning given that the majority of them will be expected to use English as the language of learning and teaching (LoLT) and will have to use mathematical tools in the teaching of various subjects.

Having responded briefly to the question 'how much?', we now address the second question 'of what', in more detail. As the disciplines differ in nature (for example, mathematics is vertically structured and English is not) and because the ways in which they are recontextualised in teacher education differ, we provide separate and, in some respects, quite different kinds of analyses of the curricula for mathematics and English.

4. Mathematics courses for intermediate phase student teachers

Mathematics for teachers

The question of what mathematics courses are most appropriate for prospective primary school teachers is the subject of on-going debate. Ball, Hill and Bass (2005) point out that mathematics courses for teachers range from those involving advanced mathematics to those aiming at teachers' mastery of the mathematics of the grades they will teach to those with a specific focus on the types of mathematical thinking a teacher needs to do. Research does not support the notion of "the more higher mathematics courses the better" for teachers (see for example, Monk, 1994 and Begle, 1972) and there is no agreement among mathematics teacher educators on exactly which types of courses are likely to best meet teachers' needs. However, there is increasing acceptance of the idea that mathematics teachers need to possess a special kind of mathematical understanding.

Ma (1999), in her comparison of Chinese and American primary school teachers, argues for the importance of what she terms a "profound understanding of fundamental mathematics (PUFM)" and proposes that teachers need a deep, connected and flexible understanding of the mathematical content that they are expected to teach. Hill, Rowan and Ball (2005) argue that what they refer to as content knowledge for teaching mathematics (CKT-M) is a particular kind of mathematical knowledge that needs to inform the work that teachers do in classrooms. This includes the ability to use a range of representations to illustrate a mathematical concept, the ability to analyse the appropriateness of alternative methods of approaching a mathematical problem and the ability to analyse the origin of misconceptions. The research of Hill and

her colleagues has indicated a link between teachers' scores on a test for CKT-M and the quality of their teaching. Although more work needs to be done to understand what kinds of pre-service mathematics courses best deliver good CKT-M or PUFM it is certainly possible to analyse courses in relation to the elements of CKT-M or PUFM evident in them.

Thus in looking at "how much of what kind of mathematics" is offered to prospective IP teachers, to understand the "of what" we looked at the nature of the mathematics offered to the student teachers in the mathematics courses. In doing this, we drew on the literature referred to above and considered the following:

i) The level of the mathematics i.e. is it advanced mathematics or school mathematics? In doing this, we mapped the mathematical content against where it would typically occur in a South African primary, secondary or tertiary level curriculum as follows:

Table 2: Levels of mathematics

IP	SP	FET	University
The intermediate phase (grades 4-6). This would include the basic operations covered in the foundation phase (grades 1-3)	The senior phase (grades 7-9)	The further education and training phase (grades 10-12)	Mathematics typically taught in mathematics departments at university.

It should be noted that the level of mathematical content does not indicate **depth** but simply the stage in the curriculum where that content is typically encountered. For example, it is possible to pose questions on university level mathematics that require only the application of well-rehearsed procedures (e.g. find the derivative of) or to pose questions on IP or SP level mathematics that are more demanding (e.g. use a contextual situation to explain why when dividing a number by, we multiply it by).

ii) Because we were aware that the content could be addressed at varying levels of depth, we considered the level of cognitive demand of the mathematical tasks student teachers encountered in the course. The taxonomy used, shown in table 3 below, draws on the work of Stein *et al.* (2000) and the Learning Mathematics for Teaching Project (2011) on the Mathematical Quality of Instruction (MQI).

Table 3: Levels of cognitive demand

Category	Description
Knowledge (K)	Recall of facts, rules, formulae
Perform routine procedures (RP)	Perform procedures that have been seen previously
Make connections (C)	Between different representations
	Between mathematics and context
	With other mathematical topics
	Between the procedure and the underlying concept

Category	Description
Engage in mathematical practices (MP)	Investigate and generalise
	Provide explanations
	Justify and prove
	Solve non-routine problems

For example, a question such as calculate would be categorised as RP, whereas the question shown below, taken from a worksheet from institution A, would be categorised as MP as it is a non-routine problem.

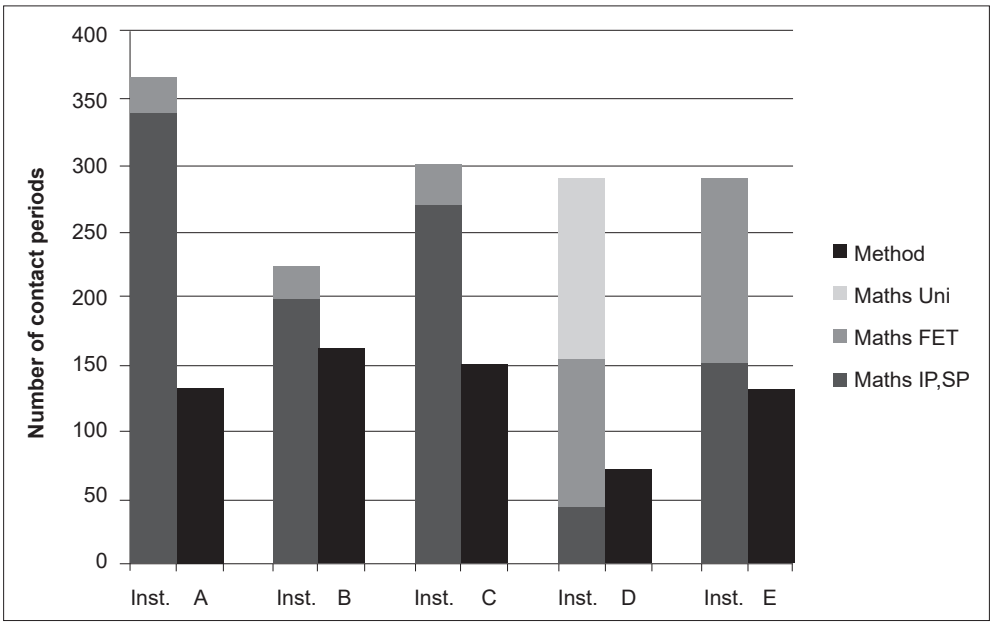
> *To celebrate World Maths Day a school asks each of the learners from the senior grades to partner with a learner from the junior grades so they can work together as a team on a maths quiz on World Maths Day. So far 2/3 of the learners from the senior grades have partnered with 3/5 of the learners from the junior grades. What proportion of learners at the school have got partners for World Maths Day?*

iii) Finally, because we were interested in whether the mathematics encountered by the teachers was specifically related to the work of teaching, we drew on Ball, Thames and Phelps (2008), who distinguish between common content knowledge (CCK) and specialised content knowledge (SCK). CCK refers to mathematical knowledge and skills used by 'non-teachers', for example, knowing how to add two numbers. SCK, on the other hand, refers to the mathematical knowledge and skills that are unique to teaching e.g. being able to analyse whether an atypical long multiplication algorithm is mathematically correct.

The results of the analysis of the courses at the five universities are summarised below. Information regarding the number of contact periods is provided for the mathematics courses and the mathematics methodology courses in order to indicate the amount of time spent on mathematics-related courses. However, the analysis of the level of mathematics, cognitive demand of the tasks and nature of the mathematics (CCK or SCK) is provided only for the mathematics courses.

Courses for mathematics specialists

Graph 1 and table 4 below summarise the amount of time spent on mathematics-related courses and the nature of the mathematics courses provided to mathematics specialists at the five institutions (labelled A-E).



Graph 1: Number of contact periods in mathematics-related courses for mathematics specialists during the four-year B.Ed. degree

Table 4: Nature of mathematics in the mathematics courses for mathematics specialists

University	A	B	C	D	E
CCK or SCK	Combine CCK and SCK	Combine CCK and SCK	Combine CCK and SCK	Only CCK	Combine CCK and SCK with focus on CCK
Cognitive demand	All levels	All levels	All levels	Mostly K and RP	Very little MP

Across the five universities, the total number of contact periods allocated to mathematics-related courses during the four-year B.Ed. degree varied from 366 to 499 contact periods.[1] At each university, except B, considerably more time was allocated to mathematics courses than to methodology courses.

At universities A, B and C most of the time was devoted to mathematics content drawn from the intermediate or senior phase levels and thus the curriculum was closely aligned to the content that student teachers are likely to teach. Although this might appear to be low-level mathematical content for tertiary students, the manner in which it was approached meant that it included some challenging mathematics. All levels of cognitive demand were represented in the type of tasks the student teachers were expected to tackle. The tasks included the need to

1 There was some variation in the stated length of the contact periods (they ranged between 45 minutes and 50 minutes). At two universities, it was impossible to discern the number of contact periods directly. Information was given in notional hours. We used the relationship between notional hours and the number of contact periods at the other three universities where information was provided to estimate the number of contact periods at these two universities.

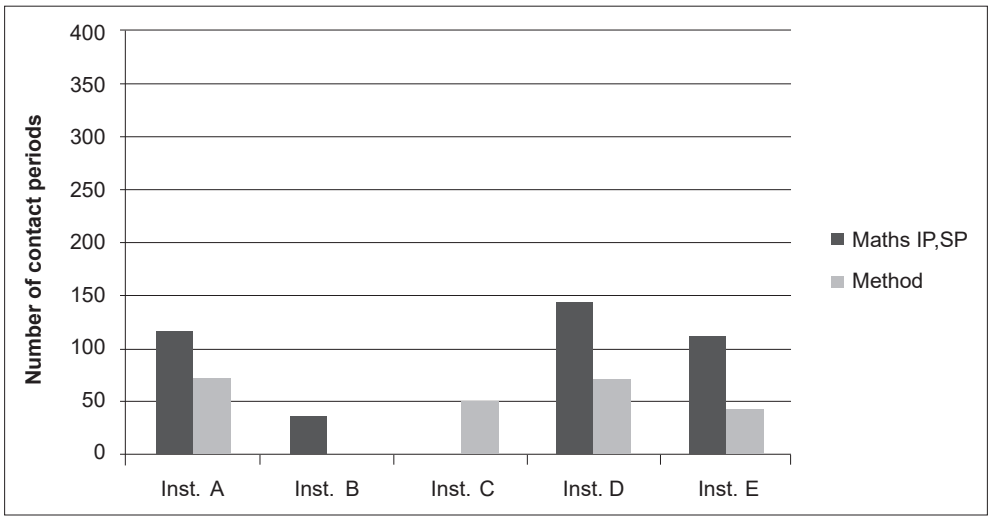
make connections between mathematical topics and different representations of mathematical ideas, problem-solving and mathematical investigations. Attention was paid to CCK and to SCK. Thus, the student teachers were not only expected to master the intermediate or senior phase content but also have the depth and flexibility of knowledge of this content necessary to design appropriate tasks to facilitate the learning of these concepts, understand alternate approaches to the content or identify and understand misconceptions.

At university D, emphasis was placed on mathematical content that is typically encountered in the FET phase or in university level courses. Although the level of mathematics offered at this institution initially seemed higher, the nature of the mathematical tasks presented to the students meant that the content was dealt with at low levels of cognitive demand. In addition, the mathematics was dealt with as CCK and the student teachers did not specifically engage with mathematics from the perspective of a teacher.

At university E, student teachers were exposed to mathematical content from the IP, SP and FET levels and thus the courses included some higher-level school mathematics. However, this higher-level content was dealt with largely as CCK and included very few tasks that required learners to engage in mathematical practices like problem solving, investigating or proving.

Courses for mathematics non-specialists

Graph 2 and table 5 below summarise the amount of time spent on mathematics related courses and the nature of the mathematics courses provided to mathematics non-specialists at the five universities.



Graph 2: Number of contact periods in mathematics-related courses for mathematics non-specialists during the four-year B.Ed. degree

Table 5: Nature of mathematics in the mathematics courses for mathematics non-specialists

University	A	B	C	D	E
CCK or SCK	Combine CCK and SCK	Only CCK	No Maths Content courses	CCK of Maths Literacy	Mostly CCK
Cognitive demand	All levels, but assessed more at lower levels			Mostly K and RP	K and RP

Mathematics non-specialists are clearly allocated significantly less time for mathematics studies than those specialising in mathematics. Of particular concern is the fact that mathematics non-specialist students at university C study only one methodology course and are not required to further their own mathematical knowledge at all. At university B the mathematics non-specialists' only exposure to mathematics is through courses on "mathematics for everyday life" taken by all B.Ed. students and thus they are not required to look with a teacher's gaze at the mathematics they may well be required to teach.

Although at university D, student teachers are offered mathematics and methodology courses. These courses are closely linked to the subject mathematical literacy, which is taken at school in grades 10 to 12 by learners who do not study mathematics. As IP teachers will not teach mathematical literacy, we suggest that preparing them to do so may not be the best use of curriculum time and in fact have been informed by the institution that the courses are being amended.

At universities A and E, mathematics non-specialists study mathematics and methodology courses. The lecturers at both institutions reported experiencing considerable difficulties in working with student teachers with widely varying mathematical backgrounds and indicated that many of these students struggled with the mathematical content even though it was largely at primary school level. For this reason, the curriculum tended to focus on CCK and tasks at lower levels of cognitive demand. The lecturers at these universities were well aware of the problems associated with this, but felt constrained by the limited time available to them. For example, a lecturer at university E commented:

> *The limited time to learn maths prevents all students from attaining the required level of proficiency. It is likely at the end of the two years the mathematics education student teachers will have sufficient procedural knowledge but not conceptual knowledge to teach beyond grade 4 or 5.*

What is offered in mathematics courses across the five universities can be summarised as follows:

(i) For mathematics specialists, there are either courses dealing with mathematical content at or just above the level of mathematics that the students will teach, in which the content is dealt with in depth and in a specialised form for teachers. Alternatively, there are courses dealing with content typically taught at higher levels (FET or university) in which the content is at low levels of cognitive demand.

(ii) For the mathematics non-specialists, the mathematics dealt with is largely at or just above the level of the learners the students will teach and this mathematics tends to be at low levels of cognitive demand. Lecturers' choices of content and cognitive level were motivated by concern regarding the inadequate knowledge of the students or by the imperative to have a course that provided prospective teachers with the quantitative knowledge and skills required in everyday life.

5. English as subject for intermediate phase student teachers

In comparison to mathematics, subject English in a BA or B.Ed. curriculum or in a curriculum for primary or secondary school learners, has a less defined disciplinary core, is less hierarchically organised and is thus less dependent on sequenced segmental connections. For the ITERP study, Banks, Leach and Moon's (1999) conceptualisation of what teachers of English need to know was used to frame the analysis of the data collected (see figure 1).

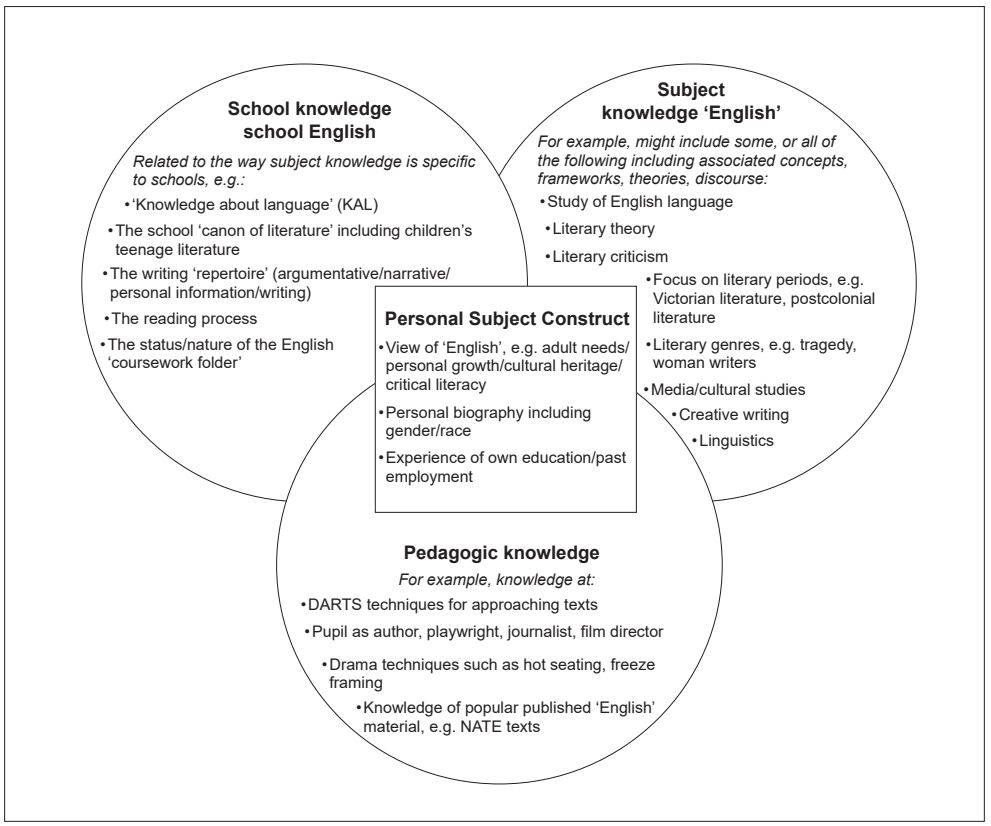


Figure 1: A model for conceptualising teachers' professional knowledge, with examples from a group of English teachers (Banks, Leach & Moon, 1999: 96)

We argue that the distinction these authors make between 'school knowledge English' and 'pedagogic knowledge' is helpful because student teachers need to know, for example, what constitutes 'appropriate' literature for children and adolescents as well as how to engage children and adolescents in reading such texts, although in the B.Ed. courses analysed, the two

are often intertwined. With reference to 'subject knowledge English', Banks, Leach and Moon's statement that the curriculum "might include some, or all of the following, including associated concepts, frameworks, theories, discourse" (1999: 96) is illustrative of the lack of agreement among teacher educators on a core curriculum for English. The range of possibilities spans language, literature, linguistics, psycholinguistics, sociolinguistics, film, media and cultural studies. Both internationally and locally, more recent teacher education curriculum frameworks for subject English are likely to include 'new literacies' (Cope & Kalantzis, 2000; Janks, 2010) in which literacy practices are considered "cross culturally, in different domains, in different discourses and as they vary in relation to different sign systems and different technologies" (Janks, 2010: 117). Locally, B.Ed. curricula are also likely to include one or more courses in academic literacy in English and, as is the case for what is selected for literary or linguistic study, the content of these courses varies greatly across institutions. Given that English is the home language (HL) of a minority of teachers and learners in South Africa, some universities include courses with a specific focus on teaching and learning English as what the school curriculum terms First Additional Language (FAL) while others do not. The presentation and analysis of data in this section begins with table 6, which summarises the courses offered by the five universities to students specialising as English teachers.

Table 6: English courses for IP B.Ed. English specialists

University	A	B	C	D	E
Academic Literacy	1 year-long course: New literacies for teachers	2 semesters: Academic and computer literacy	No academic literacy but some focus on it in Level 2 Eng. modules	2 semesters: Academic literacy	2 year-long courses: Academic literacy
Subject Knowledge	4 year-long courses: Eng. Lang. and Lit.	6 semesters: Eng. Lang. and Lit. 1-3	5 semesters: Eng. Lang. and Lit.	6 semesters: Eng. Lang. and Lit.	4 year-long courses: Eng. Lang. and Lit.
School and Pedagogic Knowledge	2 year-long courses: Language Method 1 and 2	2 semesters: Eng. as medium of instruction. 4 semesters: Eng. Method	2 semesters: Language method (one semester each for HL and FAL)	2 semesters: English method (FAL)	HL: 4 year-long courses: English method

Table 6 illustrates the differences across universities in the number of courses offered and in the weighting of subject knowledge in relation to school and pedagogic knowledge. Universities A and E both offer subject knowledge for four years (eight semesters), while institution C offers only five semesters. Regarding school and pedagogic knowledge, university E provides specialist English teachers with four year-long courses (eight semesters), while the other four offer only between two and four semesters.

Table 7 summarises the English courses for B.Ed. IP teachers who do not specialise in English.

Table 7: English courses for IP teachers not specialising in English

University	A	B	C	D	E
Academic Literacy	1 year course: New literacies for teachers	2 semesters: Academic & comp lit: 1 for all students + 1 for weak readers	No academic literacy courses	2 semesters: Academic literacy	2 year courses: Academic literacy
Subject Knowledge	None	None	2 semesters: One for Eng. Lang; one for Eng. Lit	None	Home Language 2 year courses: Eng. Lang & Lit. First Additional Language 2 year courses: Eng. Lang & Lit.
School and Pedagogic Knowledge	1 year course: Language method	2 semesters: English as LoLT (FAL)	2 semesters: English method HL and FAL	None	Home Language 2 year courses: Eng. method. First Additional Language 2 year courses: Eng. Method.

We note with concern that despite the frequent complaint that many students enter university with a weak proficiency in English and the fact that the overwhelming majority of IP teachers will teach through the medium of English, three of the universities (A, B and D) provide no subject knowledge English for students not specialising in this subject. University D also offers no school or pedagogic knowledge in English to non-specialists.

English for academic purposes

The academic literacy courses, offered to all IP student teachers at each university, contribute to very different constructions of literate teachers, as a result of the different learning focus of each one. Courses at two of the five aim primarily to fill gaps in student teachers' syntactic and lexical knowledge of English; courses at two others aim to support development of the ability to read and write academic texts and to undertake research and one institution does not offer academic literacy modules. While the need for 'gap filling' for some students is acknowledged, if this is the sole or main focus of academic literacy programmes, as is the case at universities D and E, student teachers are unlikely to gain sufficient epistemic access to the socially powerful theoretical knowledge needed to meet the requirements specified in the *Minimum Requirements for Teacher Education Qualifications* (2011) of developing 'intellectual independence' and 'some level of research competence'.

New literacies for teachers

Internationally (e.g. Heath, 1983; Street, 1984; New London Group, 1996; Cope & Kalantzis, 2000) and locally (e.g. Newfield & Stein 2000; Janks, 2010) the term 'new literacies' acknowledges (i) that people use language in different ways, for different purposes in different contexts. Therefore, *literacies* is a more appropriate term than *literacy* and (ii) that in the digital

age learners need to understand the affordances of various new forms of technology and use these new sources of information and meaning making productively. Only two of the five universities in the ITERP study offer courses (subject and pedagogic in one institution and pedagogic in the other) that enable students to engage substantively with new literacies. Given that literacies are produced and used in diverse ways within and across communities in South Africa and globally, we suggest that this lack of engagement with new literacies in several universities may leave student teachers and the learners whom they will teach underprepared to be "active, successful participants in 21st century global society" (NCTE, 2013). With reference to an observation made by one of the reviewers of this paper, we agree that some student teachers may need to extend their knowledge of 'literacy fundamentals' but we disagree that this needs to be done before they can engage with new literacies. In fact, given that they are learners at the time of the closing of the Gutenberg parenthesis (Pettit, 2012), students are likely to find support for their learning of the 'fundamentals' in their engagement with the new technologies of representation.

6. English as subject specialisation/English as subject for the 'non-specialist'

The subject courses offered to IP English specialists at each institution contribute to very different constructions of teachers of English. This is as a result of the breadth and depth of study (more courses at more levels offered in some institutions compared to others), differences in content foci (at two extremes, mainly canonical literature on the one hand and mainly descriptive grammar on the other) and the texts (including film texts) and genres chosen by lecturers. From the analysis of course outlines, assignments and interview data, the following emerged as concerns:

(i) Literature for children and adolescents, as part of the subject knowledge of an IP English teacher, is placed in the background or ignored at several universities and only given a central place in the curriculum at one (university E). Given the important role of reading in the development of IP learners' lexical and syntactic knowledge and knowledge of the world, we suggest that IP student teachers should be familiar with a wide range of stimulating texts and with ways of using such texts optimally in the classroom in both print and digital forms. For the latter the resources of the African Storybook website (www.africanstorybook.org) and of Nal'ibali (www.nalibali.org) for example, can be used.

(ii) Opportunities for IP student teachers to become critically and visually literate and to learn how to teach learners to become critically and visually literate appear to be limited or non-existent in the courses offered at three of the five universities.

(iii) Only two universities (A and E) offer courses in creative writing/writing in a range of genres. We raise this as a concern because opportunities to develop as writers are important for teachers as literate subjects and as a starting point for their understanding of how to teach learners to write in a range of genres – including understanding the contribution of text structures and language functions.

(iv) With reference to literary study, while courses at three of the five institutions could be described as 'reading rich' and courses at a fourth as adequate, at university D it appears that student teachers 'read about' plays, novels, etc. but do not engage with the texts.

The opportunities for IP 'non-specialists' to study English as subject courses, which could contribute to their development as literate teachers, vary from non-existent (at universities A, B and D) to limited (university C) to more adequate (university E). This situation (at most of the universities in the study) is worrying given that IP teachers are likely to be using English as LoLT (see below) and, as noted above with reference to mathematics, many are also likely to teach English as a subject at some stage in their teaching career.

7. Learning to teach English as home or additional language; learning to use English as LoLT

Even in the two universities which offer more school and pedagogic knowledge courses to English specialists than the other three, the allocation of time and course credits is significantly less than for English as a subject. While depth of subject knowledge is centrally important in teacher education (Shulman, 1987; Morrow, 2007) it appears that in all five B.Ed. programmes, there may be insufficient focus on equipping student teachers to guide IP learners to become speakers of English and proficient readers and writers/producers of texts in a range of genres and modes. For example, with reference to reading, the data suggest that university C is the only university that explicitly links what is involved in learning to read in the foundation phase with what is required of learners in the intermediate phase. This is another cause for concern because there is evidence (e.g. from the research of Howie *et al.*, 2008) that not all learners have become successful readers when they enter grade 4. The language and literacy challenges likely to be experienced by many learners in the transition from learning in their home languages(s) to learning in English and in developing their knowledge of English as subject, together with the challenges associated with the linguistic complexity of classrooms in many urban areas, appear to be insufficiently addressed across all institutions, although some institutions pay more attention to addressing these issues compared to others.

Across the five universities the opportunities for IP 'non-specialists' to study courses with a focus on school and pedagogic knowledge vary from non-existent (at university D) to limited (at universities A, B and C) to adequate (university E).

8. Discussion

Challenges of the intermediate phase

In our view, the following are three of the main challenges of learning and teaching in the intermediate phase:

- Once learners enter the fourth grade they are expected to use either English or Afrikaans as the language of learning and teaching, languages in which the majority of children in South Africa may have limited proficiency given that they have learned one or the other only as a subject in the foundation phase.
- Learners are expected to make the transition from 'learning to read'/learning to write to 'reading to learn'/writing to learn – a transition that involves reading textbooks and reading and writing texts in a range of genres. All of this requires knowledge of much more extensive and specialised vocabulary and more complex grammatical structures than they encountered in the foundation phase.

- In the mathematics class not only do learners encounter more specialised mathematical language but they are expected to work with more abstract concepts, an increasing number range and different types of number and they are expected to engage with algebraic ideas.

With these challenges in mind, we now return to the question of "how much of what?", in order to make our suggestions for possible changes to the current B.Ed. curricula for prospective IP teachers.

Minding the gap

Lecturers at all five universities noted that on entering a B.Ed. programme some student teachers are no more proficient in mathematics and English than the grade 4 to 6 learners they are preparing to teach. We suggest that such students require specialised support courses to enable them to master the knowledge and skills they will be expected to teach but also to develop the foundational knowledge and skills needed for accessing courses that focus on the knowledge and skills appropriate to a programme of tertiary study. We recognise that there is likely to be a negative response to a suggestion that an already lengthy degree programme be extended and to labelling some students as in need of extra help but we nevertheless suggest that such courses are currently necessary. As an alternative to extending the curriculum beyond four years, it may be possible to re-examine the overall B.Ed. curriculum and make additional foundational courses in mathematics and English alternatives to some of the elective courses in the degree. We acknowledge that this is a controversial proposal but argue that given the evidence that many students begin tertiary studies with weak basic knowledge in mathematics and limited proficiency in English, such courses are necessary for some student teachers so that they may acquire epistemic access (Morrow, 2007) to the knowledge that will enable them to enjoy and succeed in their studies and become competent teachers. One of the reasons for the weak knowledge base with which some students enter university is unfavourable teacher-learner ratios in schools. In two of the universities in the study, such ratios are perpetuated to the great concern of lecturers, one of whom said, "I'd like to have groups of 50. I'd prefer to teach the same lecture five times than to teach one class of 250".

Designing compulsory content (subject) and pedagogy courses for student teachers not specialising in mathematics and English

Many IP teachers will teach subjects in which they have not specialised at some point in their career. Additionally, as proficiency in English and in aspects of mathematics is important for learning and teaching across the curriculum, we suggest that all prospective IP teachers be required to take subject and pedagogy courses in mathematics and English in order to understand and be equipped to respond to the challenges outlined above (among others). This is in line with the specification in the *Minimum Requirements for Teacher Education Qualifications* (2011) that all IP teachers must have a sufficiently broad background knowledge to understand the requirements of all subjects in the IP curriculum.

As already indicated, mathematics in the intermediate phase requires learners to make a shift towards greater abstraction. In the foundation phase learners work largely with whole numbers which are easily represented in concrete forms. In the intermediate phase learners work with fractions which requires a greater degree of sophistication in thinking about numbers. A fraction can be made up of two different numbers (e.g. 2 and 3 in the fraction but represent a single quantity. It can be given "different" meanings (e.g. 2 divided by 3, it is 2 cakes shared equally between 3 people and it is a single cake cut into 3 equal pieces where

you take 2 of the pieces, etc.). There is a shift in number work from being able to rely largely on additive reasoning, to having to incorporate multiplicative reasoning. This shift is known to be a particularly difficult one and there are indications that many teachers themselves struggle with tasks that require multiplicative reasoning (see for example Thompson and Saldanha, 2003; Venkat and Spaull, 2015). We thus argue that the focus of the mathematical content for prospective intermediate phase teachers should enable them to understand the complexities of the mathematics of this phase and the implications of these for teaching.

In a similar vein, and in line with the requirement of MRTEQ (2011) that all IP teachers must specialise to teach languages, we suggest that all IP teachers need knowledge of what supports or hinders acquisition of additional languages. They should also be knowledgeable regarding what will assist learners to first develop what Cummins (1991) has termed basic interpersonal communication skills (BICS) and subsequently to acquire the cognitive academic language proficiency (CALP) in an additional language that contributes to success in complex academic and cognitive tasks. For the on-going development of their own literate identities, we suggest that all student teachers should have opportunities to study a range of literary and popular culture texts and to experiment with writing in a range of genres. For their work in intermediate phase classrooms, they should also be knowledgeable about literature for children and about how to stimulate children's interest in reading and in creating their own texts.

Designing compulsory content (subject) and pedagogy courses for student teachers specialising in mathematics and English

In addition to the subject and pedagogy courses that we believe should be compulsory for all IP teachers, we suggest that students who have chosen to specialise in mathematics and English should be offered courses that enable them to do the following:

(i) develop deeper and broader disciplinary knowledge (e.g. in mathematics using number theory to deepen their understanding of the behaviour of whole numbers and e.g. in English, understanding the theories underpinning critical literacy and/or engaging in film study);

(ii) To gain further insights into the ways that disciplinary knowledge plays out in schools. (e.g. in mathematics learning how to use what they have learnt about proof to help learners develop age-appropriate mathematical justifications and in English, learning how to use what has been learned from studying novels and short stories to assist IP learners to engage with characters, settings, plots, themes, etc. in a story);

(iii) To engage with a more extensive range of pedagogic strategies than it is feasible to offer the non-specialist. (e.g. in mathematics understanding the development of learners' geometric thinking in order to create mathematical tasks that foster progress in geometric reasoning and in English, learning how to design assignments that enable learners to use the affordances of a range of modes of meaning-making to demonstrate their understanding of a text).

9. Concluding comments

In reviewing literature that addresses the question of what constitutes specialised knowledge for teachers, Bertram, Christiansen and Mukuredzi (2015) note the proliferation of knowledge frameworks and the lack of a definitive answer to this question. They quote Reutzel *et al.*'s

observation that the differing frameworks constitute clear evidence of the elusiveness and complexity of specifying adequately the nature of the knowledge teachers need to teach effectively (Reutzel *et al.*, 2011). We recognise this complexity and are not advocating a 'one size fits all' curriculum for ITE across South African universities, for reasons which include respecting the diverse knowledge bases and interests with which students enter a particular university and we acknowledge the key contributions to a mathematics or English curriculum of lecturers' specific research and teaching interests. We also acknowledge the importance of other key components of a B.Ed. curriculum such as education theory courses and the teaching practicum, all of which need to be incorporated into a student teacher's timetable. We suggest that what is necessary is that teacher educators critically review the four-year programme of study for the B.Ed. degree in order to eliminate areas of overlap or unnecessary repetition. Furthermore, courses should be added that would enable all IP teachers to graduate with a competence and confidence in mathematics and English that has been enhanced by their studies and that will assist them to teach these subjects effectively and enable them to use English as LoLT across the IP curriculum.

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