

## Principals' Perceptions and Expectations of Primary Teachers with a Specialisation in Mathematics

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This study explored the perspectives of primary principals, as they consider the prospect of employing new teachers with a 'specialisation' in mathematics. Structured interviews were conducted with six NSW principals across school sectors. Analysis of the data revealed the nature of 'specialist' roles in a school depended heavily on current funding arrangements and the levels of existing expertise. The traits that principals wanted new specialists to have formed three strong themes: knowledge for teaching mathematics, personal attributes, and relationships with others – with leadership qualities anticipated across all three. We raise questions about the preparation of graduates to meet the expectations of schools.

Traditionally, the primary school teacher in Australia is considered a generalist. While this remains the case, we have entered a new phase in education history where new graduates are expected to also qualify with a 'specialisation'. The trigger for this change has been declining performance of Australian school students in international comparative tests of mathematics and science, and a perceived need to lift the competency of primary school teachers in these subjects. In 2014, the Teacher Education Ministerial Advisory Group (TEMAG) recommended to the Australian government that all primary teachers graduate with at least one subject specialisation, giving priority to mathematics, science and languages (TEMAG, 2014). Subsequently, the Australian Institute of Teaching and School Leadership (AITSL) mandated that by 2019, primary teacher specialisations be delivered by every initial teacher education (ITE) provider (AITSL, 2015a).

AITSL provided minimal guidance for the interpretation and implementation of the new Program Standard 4.4 by for the state regulatory bodies - the key statement being that graduates should "... demonstrate expert content knowledge and pedagogical content knowledge and highly effective classroom teaching in their area of specialisation" (AITSL, 2015b, p.14). The expectation primary teachers graduating with mathematics specialisation will improve student numeracy is made clear.

The success of this policy-driven initiative is likely to depend on several key factors, one of these being the ways in which a school supports and utilises new teachers with a specialisation in mathematics. This study took place before these new teachers entered the teacher workforce. It investigates the perceptions and expectations of school principals who will, over the next few years, encounter newly graduated generalist teachers with a specialisation in mathematics.

### Literature Review

Prospective primary teachers in Australia are known to hold reservations concerning their teaching of mathematics (Lomas, Grootenboer, & Attard, 2012; Maasepp & Bobis, 2018. In Hunter, J., Perger, P., & Darragh, L. (Eds.). *Making waves, opening spaces (Proceedings of the 41<sup>st</sup> annual conference of the Mathematics Education Research Group of Australasia)* pp. 551-558. Auckland: MERGA.

2014). Some would be happy if they were not required to teach it (Williams, 2009), but Pezaro (2017) argues that specialists are not the answer to teachers' lack of confidence in a subject area. She advocates that primary teachers remain as generalists because generalists have more time with their students and are better able to integrate content across subjects. However, she sees the value of having teachers able to coach their less confident colleagues. If a teacher does not fully understand a concept, they are not comfortable in teaching it and can generate student misconceptions (Betts & Frost, 2000).

Recognition of a secondary teacher as a subject specialist is based on their formal tertiary qualifications. The specialist label however, is problematic when used in relation to primary teachers. In some countries, specialist primary teachers are trained and employed like secondary teachers, only having responsibility for teaching their area (or areas) of specialisation. In Singapore for example, primary teachers graduate with a combination of two subject specialisations and these are the only subjects they teach (Khamid, 2016).

In Australia, most primary teachers are employed as generalists. A survey of 401 principals of NSW primary schools however, found that 73% had used subject specialists (Ardzejewska, McMaugh, & Coutts, 2010), subject specialists being defined as auxiliary teachers employed to teach in only one curriculum subject area. Of these subject specialists, about 40% taught Science and Technology and 30% taught Creative Arts. Just 4% were English specialists and no principal said they used a mathematics specialist. This was because principals viewed mathematics and English as the core teaching areas of generalist classroom teachers, mathematics being essential for numeracy and English for literacy. Principals' main considerations leading to their use of a subject specialist were found to be the perceived lack of expertise in the subject at their school, teachers' willingness to teach it, and their desire for the school to improve in that area.

In recent years, the term 'primary mathematics specialist' has been equated with mathematics leadership (Driscoll, 2017). A mathematics/numeracy leader is someone who has a role in improving mathematics teaching at their school (Jorgensen, 2016). These teachers may have obtained the role through receiving in-service training to improve the mathematics content and pedagogical knowledge of teacher colleagues (Driscoll, 2017; Jorgensen, 2016). Balancing classroom teaching with subject responsibility can be difficult (Driscoll, 2017), particularly when they are early career teachers (Jorgensen, 2016).

There is debate as to whether specialist subject expertise should be developed within ITE programs or should only be developed after a primary teacher has had generalist classroom teaching experience. McMaster & Cavanagh (2016) posit that pre-service teachers can benefit from a specialist professional experience placement in mathematics even prior to a generalist placement within their ITE program. In their policy framework NESAs (2016) suggests the provision of specialisation be supported by targeted professional experience with "mentoring by supportive accomplished teachers in the subject areas" (p. 2).

It is widely recognised that effective mathematics teaching in schools requires more than just the professional development of individual teachers. Teachers share improved practices in communities. The leadership of the school principal is vitally important to the development and resourcing of these communities, thereby ensuring on-going improvement in mathematics outcomes for students (Gaffney, 2012). There is anecdotal evidence that school principals perceive a need for graduate teachers with additional expertise in teaching mathematics, but we are not aware currently of any research into principals' views.

## The Study

The 2017 study was a preliminary investigation of primary principals' views about employing teachers with a specialisation in mathematics. In particular, it sought insight into their expectations of these new graduates and the roles they might fulfil in schools.

### *Context and Participants*

At the time of the interviews, no teachers had graduated with a specialisation in mathematics under the new policy, so the principals had no experience of working with teachers possessing this qualification. It was apparent that the principals had little or no knowledge of the requirements placed on ITE providers by the NSW Education Standards Authority regarding the preparation required by ITE programs for the mathematics specialisation (NESA, 2016). The principals volunteered to participate because of their interest in developing and maintaining a strong mathematics leadership team at their school, dedicated to improving the mathematics outcomes of their students.

The schools were deliberately selected to provide variety in sector, student population, location, proportion of language background (LBOTE) and socio-economic levels (ICSEA), using 2016 data found in the MySchool website (See Table 1).

Table 1

*Demographic Data of the Principals' Schools from <https://www.myschool.edu.au>*

Principal (pseudonym)	School Sector	Student Population	Location	LBOTE	ICSEA
Andrew	Government	medium size, co-educational K-6	Metropolitan	78%	957
Bethany	Government	small-medium size, co-educational K-6	Regional	5%	1000
Cynthia	Catholic system	large size, co-educational K-6	Metropolitan	74%	1029
David	Government	small size, co-educational K-6	Outer-metropolitan	9%	1036
Enid	Government	medium size, co-educational K-6	Metropolitan	26%	1161
Felicity	Independent	medium size, girls only, Junior school (K-6) within a K-12 school	Metropolitan	19%	1193

### *The Interviews*

A written set of ten interview questions was given to the principals for their consideration prior to their decision to participate in the study. On agreeing to participate, Enid chose to provide written answers to these questions. The other five principals agreed to be interviewed individually by the first author, at a time and place of their choosing. The interviews typically lasted for approximately 20 minutes. They were audio-recorded and transcribed. Most of interview questions concerned mathematics leadership roles, organisational matters and relevant funding arrangements. This paper focuses only on the last two interview questions that were about teachers with a specialisation:

Q.9. If you had the opportunity to employ a teacher who has a specialisation in mathematics, would you do this? Why?

Q.10. If you were seeking to employ a mathematics specialist who is also a classroom teacher, what would you list as the essential attributes? what would you list as desirable attributes?

### *Analysis*

A first reading of the six interview transcripts for Q9 revealed that the responses were quite specific to the school context. Therefore, the analysis approach was simply to summarise key points and look for similarities and difference across the schools. However, the responses to question 10, seeking the desired traits of newly graduated classroom teachers with a specialisation, were more complex and detailed. Therefore, inductive analysis was applied, involving multiple readings, coding of phrases and sentences, and clustering of codes into categories (Braun & Clarke, 2006).

## Results

The findings from analysis have been organised into two sections, determined by the two interview questions. During the interviews, principals used the terms ‘mathematics’ and ‘numeracy’ interchangeably, so we have not made any distinction between them.

### *The Need for Employing a Specialist Mathematics Teacher*

All the principals in this study had prioritised mathematics in their schools’ current strategic direction. However, their perceived need to employ a teacher with a specialisation in mathematics depended on the particular circumstances in their school, with the main determinants being; a) the number of existing staff with additional training in mathematics content and pedagogy, and, b) access to funding for staff training from external sources. The level of available support funding was related to the ICSEA value for the school. Schools with high support needs may have funding allocated for an *additional* staff member to fill a specialist support role. The principals of the larger schools (Andrew and Cynthia) were managing funding from short-term numeracy programs to enable on-going professional development of staff. This funding is not generally available to schools like Enid’s that have a high ICSEA value.

In the absence of a funded numeracy program, principals had classroom teachers who supported their colleagues in mathematics teaching. Bethany, working at a regional school, felt “very blessed” that she currently had two teachers who had received professional development as trainers in previous numeracy programs, acknowledging that other schools in the region were not as fortunate. At his small school, David said how “very lucky” he was to have a new early career teacher who was enthusiastic about mathematics and shared her mathematics expertise with others. He supported her self-identified professional development outside school hours.

When possible, schools without funded numeracy programs made use of external consultants. Felicity (independent school, high ICSEA) arranges training for her staff through a numeracy consultant from the Association of Independent Schools who works with teachers in their classrooms. David (small school) gave his staff a one-off professional development day with a private numeracy consultant, which was made affordable by sharing the session with staff from nearby schools in an informal community of schools.

When asked specifically about employing a general classroom teacher with a specialisation in mathematics, David, Beth and Felicity expressed enthusiasm. However, the following conversation between the interviewer, Cynthia (large Catholic school), and the diocese ‘numeracy educator’ (Cathy) who happened to also be present, revealed a preference for ‘in the job training’.

Cynthia: Well, I’d rather them be a specialist in mathematics than say creative arts. Let’s be realistic here. If you’ve got a really strong background in a curriculum area that’s always a great advantage... Well obviously, unless I’m advertising for a creative arts teacher.

Interviewer: But if it was a general teaching position, a classroom teacher?

Cathy: It’s hard isn’t it?

Cynthia: I don’t know. I don’t know that I would - there’s so many things that go into having a good CV, anything across the board to get an interview.

Cathy: It is true we like to grow them, don’t we?

Cynthia: The reality is...

Cathy: Grow them in the context.

Andrew, who also develops mathematics leaders from within his staff, mentioned looking for new teachers who are open to being mentored by the mathematics leaders at his school.

### *Attributes of Teachers with a Specialisation in Mathematics*

Table 2

*Grouping of Attributes the Six Principals Considered Essential or Desirable*

<b>Category</b>	<b>Principals who mentioned this attribute</b>
<i>Knowledge for teaching mathematics:</i>	
Curriculum	Andrew, Bethany, Cynthia, David, Enid, Felicity
How children learn	Andrew, Cynthia
Teaching approaches	Andrew, Cynthia, Felicity
Topic connections	Andrew
Mathematics education language	Cynthia
Use of mathematical representations	Cynthia
Current research	Bethany
Mathematics resources	David, Enid
<i>Personal attribute:</i>	
Passionate	David, Felicity
Helpful	Bethany, David
Sharing	Enid
Personable, respectful	Cynthia
Articulates concepts	Cynthia, David
Approachable, dedicated, flexible	David
Open to learning	Andrew
<i>Builds relationships with:</i>	
Colleagues	Bethany, Enid, Felicity
Children	Andrew, Bethany, Cynthia
Parents	Andrew, Bethany
Community	Bethany, David

As expected, the principals mentioned attributes that were not specific to the teaching of mathematics. Cynthia, Enid and Felicity mentioned before anything else, that the teachers must have good general classroom teaching skills; “How proficient they are as

teachers themselves first and foremost” (Cynthia). Attributes other than good general classroom teaching skills, fell into three clusters as shown in Table 2: knowledge for teaching mathematics, personal attributes, and the ability to build relationships with others.

a) Knowledge for teaching mathematics

This category includes traits such as knowledge of the mathematics curriculum, how children learn, teaching approaches (a problem-solving approach was specifically mentioned by two principals), current research and good teaching resources. For example, “The curriculum knowledge number one. They need to have a very high level of understanding...” (David); and, “Having a really firm understanding of what the research says around best practice...” (Bethany); and, “...a really clear understanding of how children learn and are able to articulate it” (Cynthia).

Embedded within several comments about Knowledge, was the implication of leadership: “...talk at staff meetings about things like resources” (David); and, “Sometimes, taking the lead and saying let's try it this way” (Bethany); and, “...assume responsibility for the curriculum” (Felicity).

b) Personality

All the principals believed that the graduate’s personality would be of importance. They specified traits such as being helpful, approachable, passionate and flexible. For example: “... someone who is passionate about it...be willing to assist...” (David); and, “...happy to roll up their sleeves, be in there as an additional person to support...” (Bethany). Some of these traits related to an ability to mentor others: “I have worked with people over the years who have a wonderful knowledge themselves but were not able to bring people along at the level they were at” (Cynthia). Andrew mentioned the importance of young teachers being open to learning from more experienced mathematics leaders.

c) Relationships

The principals spoke of relationships with children, parents, teacher colleagues, and the community as being critical for having a lasting influence. Mentoring and leadership expectations were framed in productive relationships. For example: “...they are people who have really strong capacity to build relationships very quickly with children” (Bethany); and, “...directing things in certain ways that create a long-term effect change for children” (Bethany); and, “...the links between the classroom and the lounge rooms of those kids involved is most important” (Andrew); and, “ability to work with a team to develop mathematics teaching in the school” (Enid).

## Discussion

The decision as to whether to employ a graduate teacher with a specialisation in mathematics is strongly influenced by the school’s current circumstances - particularly the funding they have for additional staff, and the number of 'good' maths teachers already at the school. This is because formal numeracy leadership positions in Australian primary schools are only possible through funding that is surplus to the usual funding models (Jorgenson, 2016). An important point is that, even when schools had funds to employ an additional teacher as a ‘mathematics specialist’, the role of this person was to provide professional development and support for other teachers, *not* teaching the mathematics for them. This is consistent with the 2010 survey of Australian principals by Ardzejewska, McMaugh, & Coutts (2010), and literature on the nature of mathematics leadership (Driscoll, 2017; Jorgensen, 2016). It supports the notion that in Australia, English and

Mathematics are considered the core responsibility of each primary classroom teacher and highlights the need to support the teachers who struggle to teach mathematics effectively (Lomas, Grootenboer, & Attard, 2012; Maasepp & Bobis, 2014). When funding was not available, principals still saw the need to have one or more teachers with particular strength in mathematics who could address the professional learning needs of other teachers.

However, when the conversation with principals moved away from existing arrangements in their schools to the future prospects of employing a new general-primary graduate with a specialisation in mathematics, the traits they emphasised were much less predictable from previous research. Given the widely-established concerns about the depth of mathematics content knowledge of primary teachers, we were surprised that only one principal mentioned it. Perhaps it was assumed that all such graduates would have high-level competence in mathematics. Instead, the principals spoke of *knowledge for teaching mathematics*, such as deep knowledge of the curriculum, how content progresses, and how children learn. Several principals extended this to being able to articulate their knowledge clearly, so they could share it with other teachers.

Through their emphasis on personal qualities and skill with forming productive relationships, the principals made it very clear that they expected ‘new specialists’ to extend their influence outside their own classrooms, to work with other teachers, and reach into the school’s community. Expectations for mentoring and leadership permeated all three categories of traits: sharing of knowledge for teaching; enthusiastic and approachable people; and, forming productive relationship to effect change. Interestingly, AITSL’s paper on graduate outcomes for primary specialisations (AITSL, 2017) specifies *content knowledge, pedagogical content knowledge, and highly effective classroom practice* as requirements, but makes no mention of leadership qualities. A “... capacity to share knowledge with other teachers” is listed as one possible additional feature (AITSL, 2017, p 1). The more detailed NSW policy framework goes a step further by suggesting the ITE providers might consider “... focussing on both academic and personal attributes including enthusiasm for the learning area” (NESA, 2016, p.2).

## Conclusion

It should be remembered, that although the principals in our study came from a variety of school contexts, the views of only six principals cannot be considered as representative of the perceptions of principals across the state of NSW and may give little indication of the situation in different parts of Australia. Yet the findings add to the scarce literature on this topic, by raising some interesting issues and questions.

There appears to be a mismatch between the AITSL policy guidelines for primary specialisation, and the needs and expectations of schools. The policy focusses on academic traits and practice inside the classroom. The principals emphasise personal traits and relationships outside the classroom. ITE providers, of course, attend to the academic preparation of their graduates, along with the practical preparation provided through professional experience placements. How well do ITE providers attend to the personal and inter-personal qualities of their students? Is it their responsibility to do so? Given the strong expectations of schools for ‘specialist’ teachers in mathematics to provide support, mentoring and leadership for other teachers, should graduates be explicitly prepared for such roles, or should we be trying to change the needs and expectations of the schools?

On the basis of this study we advocate the urgent need for extensive research into the multiple perspectives of policy-makers, ITE providers, schools and the graduates with a mathematics specialisation. The mathematics education community has an unprecedented

opportunity for sweeping reform in primary mathematics, operating through the imminent ‘flood’ of specialist graduates. However, we may be about to ‘get it horribly wrong’.

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