What Matters With Out-of-field Teaching: A Preliminary Analysis of Middle Years Teachers of Mathematics in South Australia

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There has been a lot of media attention about 'out-of-field' teaching, but much of it does not capture the complexities of the term or account for the range of knowledge, experience, and attitudes relevant for teaching mathematics in the middle years. In this paper we report on a survey conducted to better understand the diversity of the profession teaching middle school mathematics (Years 7-10) in South Australia. A preliminary analysis indicates that self-identification as a teacher of mathematics is a key contributing factor to confidence in teaching mathematics. We suggest that looking through an identity lens will better inform planning and support for out-of-field teaching in mathematics.

Described as "education's dirty little secret" (Brodbelt 1990, p. 282), out-of-field teaching occurs when a teacher is assigned to teach one or more subjects for which they are not qualified or adequately trained. This phenomenon is reported in many countries, including Australia, Germany, Indonesia, Ireland, the UK, and the USA (Price et al., 2019), South Korea (Kim 2011), New Zealand (Post Primary Teachers' Association, 2018), and others. Terminology synonymous with out-of-field teaching includes mis-assignment (Sharplin, 2014; Van Overschelde, 2022), teaching across specialisations (Hobbs & Törner, 2014), non-specialist teaching (Goos et al., 2019), and teaching out-of-area (Hobbs & Törner, 2019, p. xi).

The scale of out-of-field teaching in Australia is greater than in other comparable countries (Marginson et al., 2013) and is a concern for every Australian state and territory (Weldon, 2016). The problems experienced globally may be exacerbated by Australian geographical complexities such as rural and remote communities. Using the 2013 Staff in Australia's Schools survey data, Weldon (2016) reported that 17% of mathematics classes in Years 7-10 are being taught by an out-of-field teacher but that the problem is inequitably distributed, with the figure being 26% of classes in remote locations compared to 14% in metropolitan locations. These issues can compound over multiple years of schooling, with modelling by the Australian Mathematical Sciences Institute suggesting that there is a 76% chance of being taught by an out-of-field teacher in Years 7 to 10 and that 'less than one in four Year 7 to 10 students [will] have an in-field maths teacher every year' (Prince & O'Connor, 2018, p. 3).

In this paper we explore the notion of out-of-field (OOF) mathematics teaching in a South Australian context. Like others, we posit that labelling teachers as OOF is complex, particularly when it does not account for the evolving nature of their knowledge (both pedagogical and content), experience and attitudes and, as such, may create deficit perspectives of OOF teaching that are unwarranted. We show data that points to the significance of teacher identity as a key factor that should be considered when planning responses to OOF teaching in mathematics.

Defining Out-of-Field Teaching

Despite the widespread occurrence of out-of-field teaching, there is no single understanding of the phenomenon. The broad characterisation—'assigning teachers to teach subjects they are not qualified to teach' (Hobbs et al., 2022b, p. 5)—centres on criteria used to qualify teachers.

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Consequently, 'because of state, national and international differences in teacher registration, approval and certification, there is no single definition of what makes a teacher out-of-field' (Hobbs et al., 2021, p. 126). Hobbs and Porsch (2021) suggest a wider scope for out-of-field teaching, such as 'situations where teachers are learning something new, like a teacher learning to use new technology' (p. 369), while Hobbs et al. (2020, p. 1) note that, in practice, principals and teachers often judge the suitability of a teacher to teach a particular subject to a particular year level based on a range of factors and standards—not just qualification.

A multi-faceted definition of out-of-field teaching, as shown in Figure 1, was devised by Hobbs et al (2022a) based on work for the Victorian Department of Education and Training, and comprises four key categories which are elaborated below.

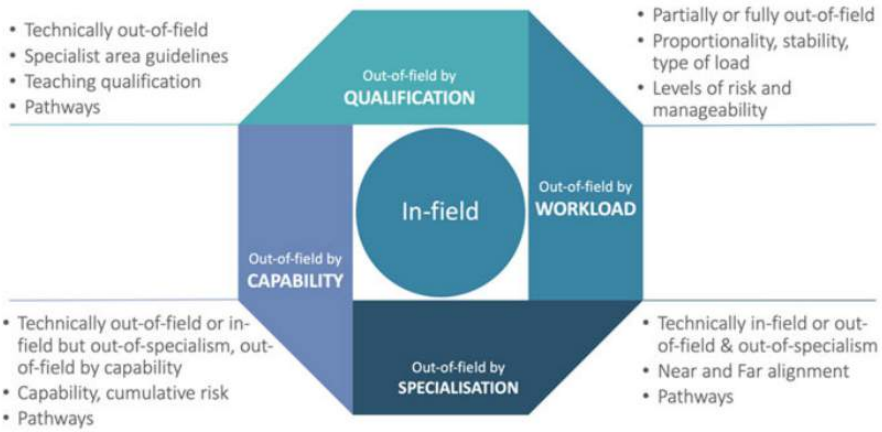

Figure 1. Multifaceted definition of teaching out-of-field from Hobbs et al. (2022a, p. 30).

In this paper we use an overarching definition of OOF aligned to the definition of 'OOF by qualification' by Hobbs et al. (2022a, p. 33), which refers to misalignment 'between the subject required to teach and [a teacher's] qualifications'. We label this QOOF. We follow Hobbs et al. (2022a) in also considering discipline qualifications (i.e., qualified to teach mathematics or not) and school level qualifications (i.e., qualified to teach primary or middle years) as part of QOOF, but separate them out as follows:

- QOOF-T: Technical misalignment between a teacher's discipline qualification and current teaching.
- QOOF-P: Phase misalignment between a teacher's school level qualification and current teaching.
- QOOF-B: Both technical and phase misalignment.

Teachers not meeting any of these criteria can be considered 'in-field by qualification', which we call QIN.

Hobbs et al. (2022a) refer to 'OOF by specialism' which considers whether there is misalignment between a teacher's qualification and the sub-discipline they are teaching. While this classification is clearly defined and understood in a composite subject area like science, it is less useful in mathematics. As such, we have not used a parallel definition in our study. For 'OOF by workload', which Hobbs et al. (2022a, p. 38) used to describe 'the proportion of load that is out-of-field at any one time or across a period of time, the stability of [a teacher's] workload allocation, and the type of load', we have used an adapted definition. We categorise the proportion of workload relative to total workload. However, this study was intended to provide a snapshot of respondents' current experiences and therefore we did not look at stability of teaching load over time.

Hobbs et al. (2022a) defined 'OOF by capability' as their final dimension, which relies on factors beyond qualification and relates to a teacher's 'perceived and/or actual capability'. Rather than make a judgement of teachers' capability, we have chosen to explore self-reported confidence, interest, and identity. In our study we have used these additional dimensions as ways in which to further understand the complexities of out-of-field by qualification.

Research Design

The aim of this study, which employed a survey-research design, is to better understand the diversity of the profession teaching middle school mathematics (Years 7-10) in South Australia (SA). The survey was designed using the principles of Hobbs et al.'s (2020) classifications of 'out-of-field', AITSL's (2021) report on the SA teacher workforce, and Weldon's (2016) study of the out-of-field issue in Australia. The survey was distributed online, via the South Australian Department for Education, for one month. All middle school teachers were invited to complete the survey, irrespective of what they were currently teaching. We opened the survey to all middle school teachers (not just those teaching mathematics) in order to capture the voices of *all* teachers working within and across these years who could be impacted (either positively or negatively) by this issue. The research questions guiding the aspects of the study reported in this paper are:

- What are the in-field/out-of-field teacher demographics of SA middle school teachers of mathematics?
- What are the teacher attitudes and levels of interest, enjoyment, confidence and commitment in teaching mathematics?

Findings

A total of 232 participants completed the survey, of which 196 have taught middle school mathematics during their career. Of this cohort of 196 teachers, 23 indicated they were teaching in a primary context (Year 6 and below) and 133 in a secondary school context (Year 7 and above) at the time the survey was conducted. This left 40 respondents who were not teaching mathematics. Each respondent was classified as QIN or QOOF (-T, -P, or -B) using information they provided about their teaching qualifications. Of the 133 secondary teachers, 60% are considered OOF, either by technical or phase misalignment, or both (Figure 2).

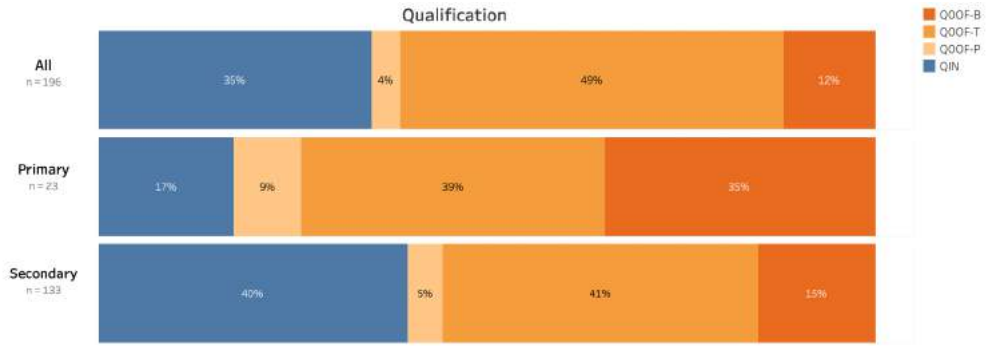

Figure 2: QIN & QOOF classification by phase (n=196).

Further exploration of the data for secondary teachers (n=133) indicates little variance between groupings by gender, and examining age revealed that 74% of respondents aged under 30 years are QOOF (-T, -P and -B), with similar percentages for the 30-39 and 40-49 age groups. In contrast, respondents aged 50+ years are more likely to be in-field by qualification, with 62% of those aged 50+ years and 68% of those 60+ years in the QIN group. Looking at teachers aged under 40 years, those teaching senior secondary mathematics (Years 11-12) are more likely to be in-field by qualification (45%) than those teaching in the middle years (30%).

The longer teachers have been in the profession, the more likely it is that they are in-field by qualification (QIN), regardless of whether they teach Years 7-10 or Years 11-12. A greater proportion of the teachers with 5-10 years' experience are out-of-field (71%) than those with less than 5 years' experience (69%). Given the findings that early career teachers are leaving the profession due to feeling unsupported and overwhelmed by workload (Johnson et al., 2014; Windle et al., 2022), this warrants further investigation.

For this sample of teachers there was little difference in the prevalence of QOOF based on school location across major cities, inner regional, and outer regional (56%, 53%, and 63% respectively) or by school category (between 60% and 66% across school categories 2-7; category 1 was 80% QOOF but with only 5 respondents cannot be considered representative).

To examine OOF by workload, we calculated the proportion of mathematics classes for respondents currently teaching in a secondary school context (n=133), and categorised by Low (0-25%), Low-Medium (25-50%), Medium-High (50-75%), High (75-100%). Figure 3 shows the proportion of workload by QIN and QOOF. There are two main features to note.

- 17% of teachers who are in-field by qualification have less than 50% of their teaching load in mathematics, with 4% having less than 25% allocated to mathematics. In the context of a shortage of teachers of mathematics, it may be worth exploring what 'other' teaching this cohort is doing.
- 50% of teachers who are out-of-field by qualification have more than 50% of their teaching allocated to mathematics.

For this sample of teachers there was little difference in the prevalence of WOOF (our term for OOF by qualification and with more than 50% of their teaching workload in mathematics) by gender. However, as age increases (and similarly, years of experience), the proportion of WOOF teachers increases. The WOOF proportion is relatively consistent across all locations (45% or more in each location), and common across all school categories. Around 50% of permanent teachers who are out-of-field by qualification are also out-of-field by workload.

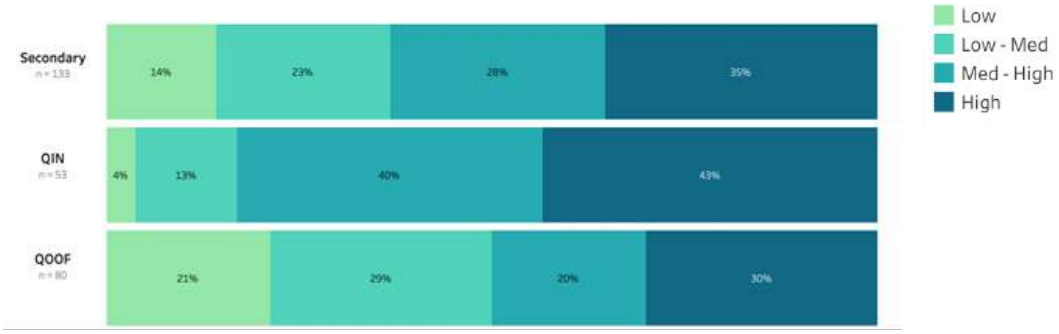

Figure 3. Secondary teachers' workload in mathematics.

Teacher Identity

As well as classifying teachers as QIN or QOOF, we asked two questions about identity. The first was whether or not respondents self-identify as teachers of mathematics. Of the 176 teachers who have taught mathematics and who responded to the question, 76.7% (n=135) self-identify as teachers of mathematics, leaving 23.2% (n=41) who do not. The second question was whether or not they self-identify as out-of-field. Of the 175 teachers who have taught mathematics and responded to this question, 33.1% (n=58) self-identify as OOF, leaving 66.9% (n=117) who do not. For convenience, we refer to the last group as self-identifying as in-field, even though we didn't explicitly frame the question in this way. Using their responses, we can assign each respondent to one of four 'identity' groups. Table 1 summarises the number and percentage of respondents in each

group for the total cohort who answered both questions (n=175; columns 2-3), as well as further broken down by whether they are in- or out-of-field according to their teaching qualifications, that is, QIN or QOOF.

Perhaps unsurprisingly, the majority of teachers who are in-field by qualification (QIN) also self-identify as teachers of mathematics and as in-field. Of particular interest are the QOOF teachers. Half of these teachers consider themselves in-field and half out-of-field. Of those who identify as in-field, 79% consider themselves teachers of mathematics. In contrast, of those who identify as out-of-field, only 51% consider themselves as teachers of mathematics.

Table 1

Self-identification as a Teacher of Mathematics and In- or Out-of-field

	All (n=175)		QIN (n=60)		QOOF (n=115)	
	Self-identifies as teacher of maths (n=134)	Does not identify as teacher of maths (n=41)	Self-identifies as teacher of maths (n=59)	Does not identify as teacher of maths (n=1)	Self-identifies as teacher of maths (n=75)	Does not identify as teacher of maths (n=40)
Self-identifies as in-field (n=117)	59.4% (n=104)	7.4% (n=13)	96.6% (n=58)	1.7% (n=1)	40.0% (n=46)	10.4% (n=12)
Self-identifies as out-of-field (n=58)	17.1% (n=30)	16.0% (n=28)	1.7% (n=1)	0% (n=0)	25.2% (n=29)	24.3% (n=28)

Teacher Interest, Enjoyment, Confidence, and Commitment

Teachers were asked to indicate their personal interest in mathematics, their enjoyment in teaching mathematics, confidence in their mathematical content knowledge (CK), confidence in their pedagogical approaches for teaching mathematics (PCK), and their personal commitment to develop their own CK and PCK. Respondents rated their responses on a scale from 0 to 5, with 0 being low and 5 being high. The means are shown in Table 2. We grouped respondents by whether they were in- or out-of-field according to their teaching qualifications (columns 3-4). To explore the impact of identity, we also grouped respondents according to self-identity as a teacher of mathematics (columns 5-6) and out-of-field (columns 7-8).

Table 2

Teacher Self-Reported Interest, Enjoyment, Confidence, and Commitment

	All (n=175)	QIN (n=60)	QOOF (n=115)	Self-identifies as teacher of maths (n=134)	Does not identify as teacher of maths (n=41)	Self-identifies as in-field (n=117)	Self-identifies as out-of-field (n=58)
Personal interest in mathematics	3.92	4.58	3.58	4.42	**2.32**	4.28	3.21
Enjoyment teaching mathematics	3.88	4.37	3.63	4.36	**2.34**	4.14	3.37
Confidence in CK	3.90	4.68	3.48	4.38	**2.34**	4.38	2.91

	All (n=175)	QIN (n=60)	QOOF (n=115)	Self-identifies as teacher of maths (n=134)	Does not identify as teacher of maths (n=41)	Self-identifies as in-field (n=117)	Self-identifies as out-of-field (n=58)
Confidence in PCK	3.64	4.23	3.32	4.10	**2.15**	3.97	2.96
Commitment to develop CK	3.83	4.35	3.55	4.35	**2.15**	4.10	3.26
Commitment to develop PCK	3.88	4.53	3.54	4.47	**2.00**	4.18	3.28

Respondents who do not self-identify as teachers of mathematics reported the lowest confidence in all six categories, and comparisons of means using an independent t-test[3] (with equal variances not assumed as per Levene's test) point to statistically significant differences (all with $p < .001$) between the groupings of teachers identified earlier. This accords with the findings by Hobbs (2012, p. 27) who found that how 'a teacher sees themselves in an out-of-field role will influence their interest and ability to engage with professional learning and professional development designed to up-skill teachers'.

We also analysed responses using the groupings introduced in Table 1; these findings are shown in Table 3. Within the QOOF cohort, the data indicates that self-identifying as a teacher of mathematics appears to have the greatest impact on their perceived enjoyment, confidence, and commitment. While we cannot generalise these findings due to the smaller sample sizes resulting from the sub-groupings (e.g. n=11), we believe this warrants further investigation.

Table 3

Teacher Self-Reported Interest, Enjoyment, Confidence, and Commitment by Identity Grouping

	QIN	QOOF			
	Self-identifies as ToM	Self-identifies as teacher of mathematics		Does not identify as teacher of mathematics	
	Self-identifies as in-field (n=58)	Self-identifies as in-field (n=46)	Self-identifies as out-of-field (n=28)	Self-identifies as in-field (n=11)	Self-identifies as out-of-field (n=27)
Personal interest in mathematics	4.62	4.38	4.11	2.33	2.29
Enjoyment teaching mathematics	4.41	4.42	4.18	1.92	2.54
Confidence in CK	4.76	4.38	3.68	2.67	2.18
Confidence in PCK	4.29	4.13	3.71	1.83	2.25
Commitment to develop CK	4.43	4.40	4.14	1.67	2.39
Commitment to develop PCK	4.60	4.42	4.29	1.50	2.25

Teacher Confidence and the Curriculum

Teachers were asked to indicate their level of confidence (low, medium or high) in teaching each strand of the Australian Curriculum: Mathematics (AC:M) and in each year level. To turn this into one summary measure, scores were assigned as follows: low = 0, med = 2.5, high = 5. The average (mean) level of confidence for each strand in each year level was computed and reported and shown in Table 4. Due to the smaller sample sizes of some cohorts, we have not reported by identity sub-groupings.

From Table 4 it is clear that self-identification as a teacher of mathematics is a contributing factor to confidence, more so than self-identification as OOF or actual classification of QOOF. Additionally, as the year level increases, confidence generally decreases. There are three exceptions to this (identified with grey shading in the cell) in which average confidence is higher with Year 8 mathematics than Year 7 for: respondents who self-identify as teachers of mathematics, respondents who self-identify as in-field, and respondents who are classified as QIN. We speculate that this indicates a lack of ease with the Year 7 curriculum by these cohorts, given that Year 7 only recently moved to secondary contexts in SA. The mean differences between each teacher grouping for Years 8, 9 and 10 are statistically different, all with $p<.001$.

Table 4

Teacher Self-reported Confidence in Teaching All Strands of the AC:M, by Year Level

	All (n=196)	QIN (n=69)	QOOF (n=127)	Self-identifies as teacher of maths (n=135)	Does not identify as teacher of maths (n=41)	Self-identifies as in-field (n=117)	Self-identifies as out-of-field (n=58)
Year 7	4.47 (n=161)	4.57 (n=55)	4.42 (n=106)	4.65 (n=124)	3.86 (n=37)	4.51 (n=109)	4.38 (n=52)
Year 8	4.41 (n=165)	**4.93 (n=57)**	4.14 (n=108)	**4.74 (n=127)**	3.32 (n=38)	**4.60 (n=111)**	4.02 (n=54)
Year 9	3.97 (n=158)	4.77 (n=57)	3.51 (n=101)	4.38 (n=125)	2.41 (n=33)	4.36 (n=109)	3.11 (n=49)
Year 10	3.48 (n=158)	4.53 (n=60)	2.83 (n=98)	4.03 (n=123)	1.55 (n=35)	4.06 (n=109)	2.19 (n=49)

The mean difference between the Year 8 teachers who self-identify as in-field in comparison with the teachers who self-identify as out-of-field is also statistically significant but with a p-value of .009. Year 7, however, is an outlier. The mean differences across all three groupings are not statistically significant suggesting:

- The confidence levels (across all strands of Year 7 mathematics) of those who self-identify as teachers of mathematics and those who don't are not statistically different.
- The confidence levels (across the strands of Year 7 mathematics) of those who self-identify as out-of-field and those who don't are not statistically different.
- The confidence levels (across the strands of Year 7 mathematics) of the teachers are QIN (qualified to teach mathematics) and those who are QOOF (not qualified to teach mathematics) are not statistically different.

Summary and Conclusion

The approach taken in this paper to examine out-of-field mathematics teaching in South Australia draws on the conceptual framing developed by Hobbs et al. (2022a). Working from their multifaceted definition, we also posit that defining and categorising out-of-field teaching is a complex endeavour. Defining OOF solely by qualifications does not account for the range of experiences, knowledge and attitudes that accumulate throughout a teacher's career. The survey data indicates that looking through multiple lenses can provide a more nuanced view.

We presented a snapshot of workload in mathematics for in- and out-of-field teachers. More analysis is needed to make inferences from the data. For example, a teacher with low maths workload might be either 'just filling in' or 'dipping a toe' into a new learning area. Similarly, a teacher with high maths workload might be completely overwhelmed or, alternatively, have gained the knowledge and confidence to teach in an area they were not initially qualified.

Identity as a teacher of mathematics, in particular, was shown to be a key factor influencing interest, enjoyment, confidence and commitment in teaching mathematics. We suggest that future planning and support for teachers of mathematics would be better informed by carefully examining OOF through an identity lens, including targeting professional learning at needs of particular cohorts of teachers.

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