Researching with In-service Teachers Teaching "out of field"

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Abstract

While there is research on the most effective forms of professional learning for teachers, there are practical difficulties associated with establishing a research project connected to such programs, which will vary for different situations.

This presentation briefly addresses some of the research around teaching out of field and its link to teacher professional learning. The paper then examines some of the methodological issues which arose while setting up a research project associated with a particular professional learning program for teachers of mathematics and science who were teaching out of field (OOF) in Tasmanian Government schools. As a joint initiative of the university and the Tasmanian Department of Education, an emergent methodology was thought suitable based on mixed-methods data collection which included pre & post surveys and interviews and artefacts.

Introduction: the extent of out of field teaching

Teachers teaching "out-of-field" (OOF) is an international phenomenon which needs more research. It refers to the situation where teachers teach in specialisations for which they have no formal qualifications. The *Teaching Across Specialisations* (TAS) Collective was formed to provide opportunities for researchers and educators to collaborate on issues associated with teaching OOF. TAS conducted a Symposium in 2014 to explore the issues surrounding teaching OOF with international colleagues interested in this area to share their experiences and to establish a research agenda (Hobbs & Törner, 2014).

According the TAS Collective, the practice of teaching OOF is widespread and, while it occurs in numerous countries, its impact is under researched. The causes of the phenomenon seem to be linked to systemic teacher supply questions and shortages of appropriately qualified teachers within certain subject specialisations which generate organisational and staffing issues in schools.

The perceived link between education and economic success inevitably means teacher preparation is a political issue, resulting in persistent calls to improve teacher quality and a raft of polices across the globe related to teacher workforce planning, pre-service preparation programs, and increasing reliance on accountability measures and standards to improve teacher quality (Cochran-Smith, 2013; Furlong, 2013). Most countries already have nominal teacher qualification requirements; the persistent shortfall of teachers in certain specialized subjects has led to programs such as *Teach for Australia* in which qualified people from related professions are recruited into teaching and to calls for differential pay to entice qualified people into hard to staff discipline areas and hard to staff schools.

In Australia, much of the efforts to deal with this issue focus on recruitment to teaching; however, there is also a need to support the teachers currently teaching out-of-field. Enticing current in-service teachers to teach OOF is a short term solution occurring around the world. The report produced by the TAS Collective was primarily focused on those teaching OOF in Mathematics and Science in Australia, Germany, the UK, Ireland and Korea. It raised questions about certification and specialisation requirements for teaching and the interplay between specialised knowledge and pedagogical knowledge for teaching in these subject areas (Hobbs & Törner, 2014).

Research indicates that teaching OOF seems to be increasing, but available data are unreliable, so estimates of its extent vary. Hobbs and Price (2014, p.11) cited the OECD average of about 18% of those teaching OOF and claimed that, in some secondary subjects, "Australian students are more likely to be enrolled in schools with a lack of maths and science teachers than other OECD countries." They also presented data from numerous other reports showing estimates of those teaching OOF in Australia ranges from 15-25%, with an alarming 38-50% suggested in mathematics and physics. One of these reports (McConney and Price, 2009) described the situation in Western Australia (WA) where OOF teaching was "higher in Catholic and Independent schools and considerably higher in country schools across all sectors" and "teachers teaching out of field had over 21 years experience – calling into

question conventional wisdom that it is often new teachers assigned to teach out-of-field". The latest Staff in Australian Schools Survey shows a slight downward trend in the extent of out-of-field teaching, particularly in the sciences and mathematics.

Schools have to find ways to deal with teacher shortages so, although teacher education programs in Germany, Ireland and Australia, for example, specify qualification requirements for teachers of subject specialisations, once teachers are in a school, the principal is "legally allowed to assign them any subject" (Bosse & Törner, 2014, p. 5). Hobbs and Price (2014, p.12) also noted that "most schools assign teachers out of field and / or narrow (the range of) subjects offered due to lack of staff." This indicates that local needs tend to trump certification requirements at the school level.

In Ireland, Ní Ríordáin (2014, p.19) claimed "out-of-field (OOF) mathematics teaching is prevalent" and "younger and weaker students are generally taught mathematics by OOF teachers." To some extent though this may be related to the broader question of the decline in students choosing STEM subjects world-wide, leading to fewer graduates in these areas, thus setting up a "Catch-22" situation (Marginson et al, 2014).

Dealing with the reality of OOF teaching firstly requires that the phenomenon is acknowledged so that steps may be taken to address the problem. Three possible approaches offer by Hobbs (2014) are:

1. Reducing the need for OOF teaching by increasing the supply in hard to staff areas in the longer term.
2. Improving the quality of teachers currently teaching OOF in the short term through up-skilling.
3. Increasing teacher readiness of teacher graduates to deal with the possibility of teaching OOF.

In some situations, professional learning PL programs are organised to support those teachers teaching OOF and they may be released from their classes for a period to attend sessions (e.g. Ireland, Germany, UK and Australia). Most of the programs reported are quite recent and linked to mathematics teaching, have certain requirements for selection of participants and a strong focus on content knowledge, with some, usually lesser, emphasis on pedagogical knowledge (Hobbs and Törner, 2014). There is little research in the way of evaluation of the effectiveness of the programs as yet. This paper explores the second of these approaches through the provision of a professional learning (PL) program for OOF teachers in Tasmania.

Understanding out of field teaching

Hobbs (2013) suggested that teaching OOF relates to teacher identity. Drawing on Akkerman and Bakker (2011), she argues that when teaching OOF, teachers who lack expertise to teach in that area experience a "boundary crossing" event. "Discontinuity" arises when there is disjuncture between the familiar and unfamiliar; such a discontinuity presents the teachers with an opportunity to learn, but she argued, how a particular teacher perceives this opportunity is affected by a number of factors which can have a bearing on his or her ability, or willingness to learn from the experience. She proposed the *Boundary Between Fields* (BBF) Model (Figure 1) to

explain the range of factors that influence whether a teacher who is teaching OOF self-identifies as such. These factors relate to: the context in which they work, the support mechanisms available to them, and their own personal resources.
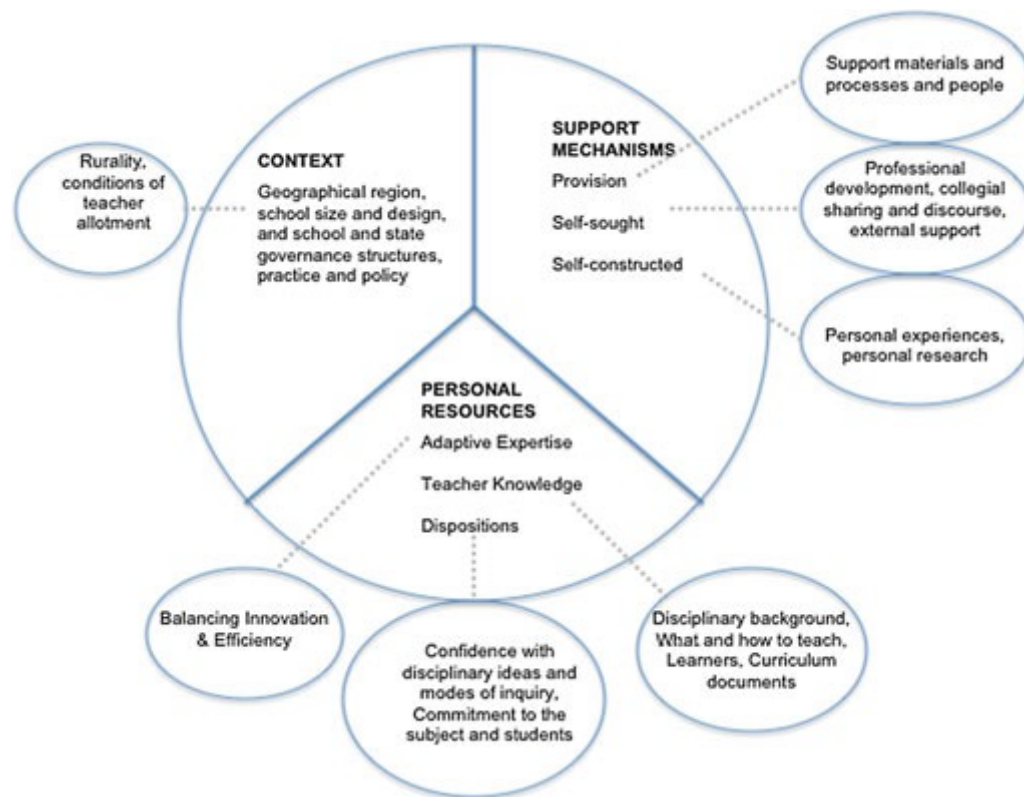

Figure 1: BBF model- Factors influencing teachers' identifying as 'out-of-field' (after Hobbs, 2013, p. 286)

In-experienced teachers tend to be more challenged by teaching OOF because of their limited knowledge and experience base, while more experienced teachers may have access to a solid base of general pedagogical knowledge (Wallace and Louden, 2002). However, irrespective of experience, how individual teachers orient to a subject they are teaching OOF may also depend on such things as: whether they see themselves as simply 'filling in' for someone; making the most of an opportunity by endeavouring to maintain high levels of student engagement and achievement; or pursuing an interest because they have a high level of self-efficacy arising from positive historical interactions with the subject (Hobbs, 2013).

School leadership also plays a strong role in supporting the development of teachers teaching OOF so it is important that they are aware of a particular teacher's areas of need. Providing support for OOF teachers, such as extra time for preparation and to work with subject-specialist mentors in the school area are needed so that opportunities to teach the subject can lead to a sense of success (Wallace and Louden, 2002).

Dealing with out of field teaching

The BBF model highlights the need to be aware of where the discontinuities, and thus the learning opportunities, arise for individual teachers:

> Because the discontinuity is individually determined, one-size-fits-all approaches to professional learning are inappropriate. (Hobbs, 2013, p. 294)

So the BBF model has clear implications for the design of PL for those teaching OOF:

> The BBF model provides a platform for re-conceptualising these experiences as opportunities for professional learning occurring within schools as communities of practice where teachers are supported and enabled to expand their professional identity (Hobbs, 2013, p.293).

Hobbs and Törner (2014) provided examples from around the world of approaches taken to PL for those teaching OOF. Most seem to concentrate on mathematics. In Ireland, a government sponsored program called the Professional Diploma in Mathematics for Teaching (PDMT) program was established to up skill those teaching OOF in mathematics, and included content and pedagogy units. It was designed as a 2 year part-time blended learning program comprising about 490 hours of sessions; participants must be registered teachers and currently teaching mathematics in a second level school but qualified in a discipline other than mathematics. Faulkner (2014) reported that evaluation of the program is conducted through tests of content knowledge.

In Germany, the DZLM or *German Center for Mathematics Teacher Education* is a consortium of several universities working with regional governments to offer district-based training courses for OOF teachers in mathematics (Lünne, 2014). The focus is on developing teachers' content knowledge and pedagogical content knowledge, however the content covered varies across the districts. In one such program teachers cover the content of the secondary school mathematics curriculum and the teachers are required to attend all 40 training days each of six hours (estimated at 240 hours duration). On training days the participants do not teach at their regular school. The sessions include reflection of pedagogical issues, which are explored through means of video and observation of highly competent teachers. At the time of reporting, no evaluation had been conducted.

In the UK, Crisan and Rodd (2014) reported on the Subject Knowledge Enhancement (SKE) courses commissioned and funded by the Teacher Development Agency and designed for serving teachers, qualified in subjects other than mathematics but currently teaching secondary mathematics. The SKE program covered content and pedagogical knowledge in Mathematics by including school based activities and tasks, which included reflections and mentoring. A research project associated with the SKE drew on Wenger's communities of practice to analyse five case studies to understand how the teachers formed their new identities as teachers of mathematics.

Hobbs' (2012) BBF model frames the learning needs of those teaching OOF as an identity issue, and PL opens up opportunities for "identity expansion and a re-conceptualisation of practice" (Hobbs, 2013, p.274). She argued therefore that PL should be tailored to suit the needs of individual teachers, but there was no indication of how this might be done in practice and, while there is an extensive body of

literature relating to teacher processional development generally, there is little broad scale analysis of what constitutes effective PL for OOF teachers.

Effective teacher PL for out of field teaching

There is an extensive body of literature concerning the characteristics of effective teacher professional learning which is beyond the scope of this paper. One study of 1027 teachers, by Garet et al. (2001), identified structural and core features of effective teacher PL programs (Table 1). In this framework, "Structural features" are concerned with the design of the PL activities and include the form, duration and degree of collaboration of the activities. "Core features" relate to the substance of the PL program including the degree of focus on subject-specific content knowledge, the extent to which it provided opportunities for active learning and the coherence of the activities with other demands, needs, and expectations of teachers (Table 1). In regards to the structural features, Garet et al. (2001) found that a key element in effective PL was its duration, moreso that whether it consisted of traditional workshops or reform type activities. Largely because sustained PL activities promote coherence and teachers are more likely to be able to discuss content and to explore different teaching strategies in their classrooms. Collective groups learning are thought to be more likely to sustain change due to the implicit support from their organisation and colleagues. Their paper makes no mention of blended learning activities within the structure.

Table 1: *Framework for effective teacher PD (Garet et al., 2001)*

Structural features	Core features
Form: The type of activities involved: Workshops or conference compared to "reform" activities such as network, study groups and mentoring.	**Content:** The degree of focus on improving teachers' content knowledge (in maths and science) e.g. subject specific or more general teaching topics)
Duration: The number of hours of PL activity and the span of time over which it was conducted activity	**Active learning:** The degree to which PL offers teachers opportunities to become engaged in the meaningful analysis of teaching and learning (e.g. observe experts, review student work, get feedback on their teaching, give presentations & lead discussions.)
Collective participation: The degree of emphasis on groups of teachers from a school learning together or individual teachers from many schools	**Coherence:** The degree to which PL fits with broader educational agendas to reform teaching, links to previous PL and encourages continuing professional communication among teachers.

Teachers who reported enhanced knowledge and skills were more likely to report change in their practice as were those who perceived coherence in the PL program. In the context of the paper this means knowledge about specific content and how to teach it. Coherence, which refers to opportunities to link with previous PL and priorities and to foster professional conversations was also important:

> …providing activities with multiple high-quality features is challenging, and requires a substantial amount of lead time and planning, which schools and

districts may not always have. Second, providing activities with these high-quality features is expensive.

(Garet et al., 2001, p. 935)

While concerned with teacher PL more generally, this way of conceptualising PL may help to design programs which address the specific discontinuities associated with teaching OOF. Hobbs (2013) also suggests that the design of effective of PL for those teaching OOF needs to be based on a clearer understanding of the motivations and resources of the teachers involved in teaching OOF.

The methodological question proposed her is: Can these two approaches to be amalgamated in some meaningful way to maximise the effectiveness of teacher PL associated with teaching OOF and enable research in this area?

As the "structural features" relate to the design of the PL while the "core features" are concerned with the substance of the PL experience, it is possible to conceive of a program for those teaching OOF that draws on the principles of good practice in terms of its form, duration and participation while the core features are tailored to suit the needs of the individual teachers (or group of teachers) in terms of content, active learning and coherence. Table 2 attempts to do this by framing a number of questions for each feature based on the BBF model within the framework proposed by Garet et al. (2001).

Table 2: *Framework for designing effective PL programs for those teaching OOF*

Structural features	Core features
Form: (Includes Context) • What organisational resources are available to conduct the PL program? • Who will coordinate the PL program? • How will the participants be selected? • How many teachers will be accommodated? • Are there any rurally based teachers involved? • Where and how will the PL be conducted? • Who will facilitate the program? • To what extent will blended learning approaches assist in the delivery of the program? • To what extent will the teachers need to be released from their regular duties? • How will the teachers be replaced?	*Content (Includes Personal Resources)* • What disciplinary content is to be covered? • What pedagogical content is to be covered? • How can the material be tailored to meet the needs of this teacher or group of teachers?
Duration: (Includes Context and Support Mechanisms)	*Active Learning (Includes Personal Resources)*

- How long should the PL take?
- What type of sessions should be planned?
- How many and how often should they be conducted?
- What specific demands are there on the time and workload of the teachers?

- How can the learning activities be designed to enable the teachers to engage in meaningful analysis of teaching and learning?
- How committed are the teachers to learning and practising in this discipline?
- What key pedagogical practices are important for the teacher to build expertise?
- How can the learning activities be linked to their teachers' normal work situation?
- How will the teachers' learning be assessed?

Participation: (Includes Context and Personal Resources.)

- What are the desired characteristics of the participating teachers?
- How will the selection process ensure the teachers selected are appropriate?
- How do they differ in their needs as individuals? Are any teaching in a rural school?
- How can their participation be facilitated? Blended learning? Timing of program?

Coherence: (Includes Support Mechanisms)

- What are the expectations of the school and educational system?
- What are the expectations of the participating teachers in terms of their commitment to the discipline?
- How will the expectations of each party be communicated?
- How will the teachers' workload be adjusted to enable their active participation?
- What specific supports are offered by the school in the school or system?
- What are the prospects for the teachers in terms of their on-going practice in this discipline?
- What are the expectations in terms of their future career development and certification?
- How will the PL be evaluated?

In Table 2 there is overlap with the BBF model in terms of the features of PL. The questions posed for each feature may enable the PL to be designed for a particular group of teachers with the most effective structure and the core features, thus minimising difficulties associated with ineffective or inappropriate activities or lack of adequate resources.

Application of the approach to research the effective teacher PL for out of field teachers in Tasmania

In Tasmania there is a significant issue with TOOF. In recognising the problem, the Tasmanian Department of Education approached the University of Tasmania to develop a professional learning program design to up-grade the skill and knowledge of those secondary teachers teaching OOF in science and mathematics. This study explores the evolution of the design and effectiveness of the PL program, which was conducted in term 3, 2015.

Initial discussions with the Department indicated that they would call for expressions of interest from teachers who were currently teaching science or maths OOF and who had at least 5 year's teaching experience. They were to be relieved of teaching duties for term three (essentially ten weeks) to undertake a PL program, to be offered by teacher education staff in the Faculty of Education. Thus certain elements of the structure and core features were already agreed. In the short term, the Faculty was to offer two post-graduate units, one in science pedagogy and one in mathematics pedagogy, to the selected participants. In an attempt to maximise the learning opportunity, the academic staff requested that the staff retain access to at least one class during the term to enable an emphasis on "active learning" throughout the program.

The Faculty also proposed a longer term solution to address the supply of certified teachers which would involved negotiation with the Science Faculty at the University to develop a graduate program to prepare more qualified teachers in the longer term and secondly to offer courses for those teachers in the program to obtain the required content knowledge background.

Both the science and maths PL programs focused on content knowledge and pedagogical content knowledge. The science PL which is the focus of this paper had a particular pedagogical focus on developing teachers' skills in using student-generated representations, planning inquiry units using the 5Es approach, and assessing students' understanding. The maths PL program focused more on developing teachers' content knowledge and ability to run problem-solving activities.

Evaluating the PL program

As the preparations progressed through the early part of 2015, the Minister of Education in Tasmania, insisted that the program be re-structured to offer participants a choice of four units of science OR four units of Mathematics with a view to calling the participants 'specialist' teachers of mathematics or science. The academic staff tasked with the development of the PL program expressed concern, not only about the extra workload that would arise for them in terms of preparation and teaching the units, but also the unreasonable workload to be placed on the participating teachers. There were also concerns that the participating teachers would not meet the tertiary content requirements in mathematics or science to be considered 'specialists' in these areas. This would require further study within the context of a longer PL program and there was no clear commitment to this occurring.

This paper reports on some of the methodological issues associated with the PL program which was originally proposed to run for ten weeks as a PL support program for those teaching OOF in the form of two post-graduate units, one in science pedagogy and one in mathematics pedagogy to the selected participants (i.e. two units) but due to the changes outlined above, each unit had a duration of only 5 weeks.

A research project was established to evaluate the effectiveness of the program. Due to the innovative nature of the program, an emergent methodology was thought appropriate for the research using a mixed methods approach (Greene et al., 2011). Data included: a pre and post questionnaire (adjusted slightly for participants according to whether they were teaching science or mathematics), pre and post interviews, assessment artefacts, observations, and communications (including email) made during the units and program evaluations.

Thus the planned data-set included both quantitative and qualitative data. Analysis of the quantitative data enable the identification of statistical trends, while open text response questions and the interviews provided rich explanations of the experiences of the teachers (Creswell & Plano Clark, 2007). Multiple forms of data also enable validation of the findings through 'triangulation' (Denzin & Lincoln, 2000; Zeichner & Noffke, 2001).

Ethical issues arose for the academic staff who were both conducting the research and teaching into the program. To alleviate potential conflicts of interest, teacher participation in the research was optional and did not have any bearing on the individual's participation in the PL program. An external evaluator was appointed along with a research assistant to administer the research and collect the data during the teaching and assessment phase, so that the names of those participating were unknown to the academic staff teaching in the program.

Preliminary data analysis:

As the teaching and assessment has only recently been finalised, data are still being collected, however some initial findings indicate that there were positive outcomes and some areas for improvement. The following table draws on teachers' reflections from their assessment tasks and relates to only the last science PL unit in the 4 unit program which was focussed on the use of student generated representations to understand and promote student thinking.

Table 3: *Initial feedback from science teachers TOOF*

Features of PL	Positive outcomes	Areas for Improvement
Structural	• Teachers found the face to face sessions valuable to hear what others were doing and to get ideas. • Tasmanian schools are largely rural or remote so some blended learning activities were planned.	• Fitting too much (4 units) into one term had a detrimental effect on the PL outcomes and teacher satisfaction. • Teachers did not engage in the online activities. • There was a lack of communication or understanding of PL requirements such as the

		release from normal duties.
Core	• The opportunity to share experiences with others in the class was valuable • Teachers reported a commitment to shift from a teacher centred didactic approach to a more student centred inquiry approach. • Teachers proposed that they saw enough engagement with inquiry in their students to persist with the SGR approach. • One teacher reported a culture of risk taking and learning is encouraged at his school.	• There was insufficient time to try out the SGR activities in a class • There was insufficient time to work through the 5Es and use SGRs to develop conceptual understanding. • There was insufficient time to develop student awareness and proficiency with SGRs as a mode of thinking. • There was insufficient time to develop questioning skills to promote inquiry. • Some principals did not release staff from other duties. • Some staff reported professional jealousy by their science education colleagues in the school. • Some teachers did not have access to a class as required under the PL program.

In this type of change environment where teachers are retraining in a new area, an expected outcome is that they become legitimate 'science- or maths-trained teachers'. According to the BBF model mentioned above, factors that can make a teacher *feel* out-of-field are not just the personal resources of the teacher, that is their content and pedagogical content knowledge, their adaptability, commitment to the subject, confidence etc. But also the support they receive from within their school and externally, and contextual factors such as leadership style and rurality, all contribute to how a teacher identifies with their role as teacher of the subject. While this preliminary data shows some success in attending to teachers' personal resources, that is, in building knowledge of content and strategies to teach and some shifts in beliefs, there was also evidence that the learning gains were for some teachers restricted by the short duration which left insufficient time to implement the new strategies in their classrooms or progress through the stages of the 5Es.

There is also some evidence that contextual factors may have impeded the success of teacher learning, for example, decisions by school leadership that work against the expectations of the program (not releasing teachers, not having a class to practice their new skills), and poor communication among the various stakeholders involved. Support appears to have been received from peers within the PL program, which may have been further developed had the online materials been utilised. School-based support is essential for teachers undergoing change, however, there is little evidence

thus far to show that this support was provided, in fact, jealousy from other science staff experienced by one teacher suggests that the teacher remains on the periphery of the legitimately science-trained teachers.

What can be learned from this? For any retraining program to be successful there needs to attention not just to building teachers' capacity to teach the out-of-field area. But there also needs to be attention to the school culture within which the teacher operates. An institutional culture of support is necessary to support the retraining teachers in developing their new sense of self as legitimate teachers of the subject. This support must come from the other teachers, but also from a supportive leadership approach that appreciates the subtleties and demands of teacher change.

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