Design Principles of Mathematics Placements that Support Beginning Teachers to Flourish

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School-based placements play a central role in preservice teachers' professional preparation and identity formation. Drawing on self-determination theory, a qualitative longitudinal study with 98 participants identified four placement features that supported secondary mathematics preservice teachers' flourishing identities through the development of autonomy, competence, and relatedness. These features are conceptualised as design principles for effective secondary mathematics placements that support flourishing, highlighting how placement environments can be intentionally designed to support preservice secondary mathematics teachers' development.

Introduction

Teacher education programs aim to prepare teachers to effectively support diverse students in varied classroom environments. Within initial teacher education (ITE), preservice teachers (PSTs) develop pedagogical knowledge and form an emerging mathematics teacher identity through participation in university coursework and school placements (Darragh, 2016; Shulman, 1987). Placements are central to teacher preparation and identity formation as they allow PSTs to engage in authentic teaching practice (Pendergast et al., 2020).

During placements, PSTs observe experienced teachers, interact with students, and gradually assume responsibility for planning and delivering lessons. These experiences provide opportunities to connect theoretical ideas about teaching with classroom practice and play an important role in shaping PSTs' emerging identities as teachers (Loughran, 2013). In mathematics education, placements are particularly significant. Teaching mathematics involves complex pedagogical decisions. These decisions include selecting representations, responding to student misconceptions, and designing tasks that support conceptual understanding (Shulman, 1987). As PSTs engage in instructional decision-making, they begin to form perspectives about the nature of effective mathematics teaching and their capacity to succeed in the profession. However, placement experiences can vary substantially. While placements are intended to support PST development, some environments provide opportunities for experimentation and reflection, whereas others limit PSTs' roles to observing or replicating established teaching routines (Zeichner, 2010). Despite the recognised importance of placements within teacher education, relatively little attention has been given to identifying placement features that support secondary mathematics PSTs in developing positive identities.

In this study, we examine secondary mathematics PSTs' placement experiences using the concept of *flourishing* teacher identity. Drawing on self-determination theory (SDT), flourishing is understood in relation to the extent to which environments support PSTs' needs for autonomy, competence, and relatedness. The study addresses the following research question: **What features of secondary mathematics teaching placements facilitate environments that support preservice teachers' flourishing identities?** To answer this question, PSTs' experiences of placements were examined to understand the ways in which they impacted their identity, specifically in relation to their sense of belonging, autonomy, and competence.

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Conceptual Framing: Flourishing Teacher Identities

In coining the term *flourishing identity* for mathematics teachers (Reid O'Connor & Zunica, 2024), we draw on SDT to conceptualise this as a positive mathematics teacher identity characterised by PSTs' sense of autonomy, competence, and relatedness (Ryan & Deci, 2017). Consistent with contemporary research, identity is understood as a dynamic state that is shaped through participation in professional contexts such as school-based placements (Darragh, 2016). The term *flourishing* is deliberately used to emphasise developing "in a healthy or vigorous way, especially as the result of a particularly congenial environment" (Oxford English Dictionary, 2023). Within SDT, the psychological needs for autonomy, competence, and relatedness are strongly associated with job enjoyment, professional wellbeing, and career retention (Hobson & Maxwell, 2017; Reid O'Connor & Zunica, 2024). These associations make the satisfaction of these needs particularly relevant for understanding mathematics teachers' career trajectories. Teaching placements are critical sites in which these psychological needs may be supported or constrained, shaping PSTs' identity and future work lives.

Flourishing identity in this study is examined through PSTs' experiences of autonomy, competence, and relatedness during school-based placements. Drawing on Ryan and Deci's (2017) work, autonomy is understood as PSTs' opportunities to exercise meaningful pedagogical agency in mathematics classrooms, including making instructional decisions. Competence refers to PSTs' developing confidence in their capacity to teach mathematics effectively, supported through feedback, guided experimentation, and reflection, with experiences of struggle framed as integral to learning rather than as failure. Relatedness is understood as a sense of professional belonging, shaped through mentoring relationships and departmental cultures in which PSTs are recognised and included as legitimate members of mathematics teaching communities. Growth mindset (Dweck, 2006) is additionally positioned within this framework as a *protective mechanism* that shapes how PSTs interpret challenge, feedback, and uncertainty during placements. A growth mindset reflects a disposition through which PSTs persist when encountering pedagogical difficulty (competence), engage in instructional experimentation (autonomy), and seek feedback and re-engage following setbacks (relatedness). Through an SDT lens, a flourishing mathematics teacher identity is also positioned as situated and relational, formed through PSTs' interactions with mentors, students, and the broader school community. This shifts attention from whether PSTs flourish as a result of individual dispositions alone, to the intentional design of placement environments that support flourishing. In this study, we therefore treat flourishing identity as a *design target* and focus on identifying placement features that support its development.

Methodology

As flourishing identity is understood as situated and relational, and shaped through PSTs' interpretations of their placement contexts, identifying placement features that support flourishing requires close attention to PSTs' lived experiences during placement. Guided by the conceptual framing, a qualitative, longitudinal design was employed to examine PSTs' placement experiences and answer the research question. Data were collected between 2023 and 2025 with two cohorts of secondary mathematics PSTs from one Australian university (n=98). Surveys, qualitative reflective tasks, and interviews were utilised to capture PSTs' experiences of autonomy, competence, and relatedness during placements, as well as the ways these experiences shaped their developing identities. Not all participants contributed to each data source; survey and reflective task data were collected at single time points, while interviews followed a subset of participants longitudinally across placements.

Placement experiences were examined qualitatively through responses to four open-ended survey items (n=27) asking participants: "what did you enjoy most about placement?" and "what experiences influenced your anticipated interest in teaching mathematics/autonomy in

their future teaching role/and willingness to try new mathematics teaching approaches?" (n=27). In addition, participants completed an open-ended, reflective task which asked them "how did placement experiences influenced your conceptions of mathematics teaching?" (n=60). These were administered after participants first placement experience (midway through their degrees). Finally, to capture placement experiences across an entire secondary mathematics ITE program, interviews were conducted with 11 participants (who are given pseudonyms) across all three placements to form case studies. Analysis for all data sources was conducted thematically by first inductively coding responses before interpreting patterns through the conceptual lens of autonomy, competence, and relatedness (Clarke & Braun, 2017). Triangulation across multiple data sources and longitudinal data supported the trustworthiness of findings, enabling examination of cross-cohort patterns across diverse contexts.

Findings and Discussion

Across all data sources, PSTs were highly reflective about placement experiences and their developing mathematics teacher identities. One PST reflected on "realising how the way you teach is far more important than what you teach". Another noted "my understanding of a secondary mathematics classroom has not changed…what has changed is my understanding of myself as a mathematics teacher", highlighting placement's critical role in identity formation. Analysis of surveys, reflective tasks, and interviews identified four recurrent themes, presented as design principles, characterising placement environments that support PST flourishing.

Design Principle 1: Structured Autonomy in Mathematics Teaching

Placement environments differed in the level of instructional autonomy PSTs were provided. PSTs flourished when placements balanced independence with guidance, allowing responsibility to increase as confidence and competence developed. In early placements, PSTs developed confidence when expectations for lesson planning, observation, and participation were clearly communicated. At the same time, reflective task responses highlighted the importance of giving PSTs sufficient autonomy to develop their individual teaching approach, with a PST noting "what I expected going into placement is trying to be someone like Eddie Woo, but the reality I needed to face is I need my own personal teaching style".

Interview data illustrated how structured autonomy operated in practice. Mich's first placement provided prescriptive lesson templates alongside clear expectations for reflection and feedback, enabling autonomy to emerge within supportive constraints. Mich noted "we are provided resources; she doesn't pressure us to use them". Similarly, Tal's first placement gave scaffolded autonomy in creating worksheets and choosing examples. In the latter half of the placement, Tal was able to take pedagogical risks with supervisory support, and it encouraged them to adopt "our own style". Gradual release of responsibility meant that Tal developed confidence throughout placement two ("I gain[ed] more confidence in the classroom"), and by placement three felt prepared to implement diverse pedagogies ("I enjoyed being able to do my own thing…and like do lots of games"). Contrastingly, PSTs emphasised that autonomy without structure was a stressor. Lem described uncertainty when expectations for observation and participation were unclear, resulting in them not knowing "what to take away" from lessons and hesitant to engage with students. In contrast, Peri noted that knowing "exactly what was expected of us" from the outset reduced anxiety and allowed them to focus on their teaching.

Placements with clear expectations, regular feedback, and gradual release of responsibility enable PSTs to transition from observation to supported teaching and ultimately independent practice (Byth, 2026; Collet et al., 2025). From a SDT perspective, structured autonomy supported PSTs' emerging sense of agency and ownership, allowing for the development of their own teaching identity even when lessons were imperfect. Autonomy was experienced as developmental rather than absolute, with supervisors needing to evaluate PSTs' growing

competence across placements to enact suitable supports. Allowing autonomy to make key instructional decisions is formative for PSTs' mathematics teacher identity, as identity develops through agentic participation in teaching practice (Beauchamp & Thomas, 2009).

Design Principle 2: Mathematics-specific Mentoring

PSTs' developing sense of competence was associated with mathematics-specific mentoring. Whilst PSTs typically entered placements primarily concerned with behaviour management, mentoring that directed attention towards students' mathematical understanding, representations, and misconceptions was associated with increasing their teaching confidence and identity. When mathematics-specific mentoring occurred, PSTs described shifts in how they understood the nature of mathematics teaching, recognising it was "not about teaching facts" but "helping students develop a way of understanding the language of mathematics", and that "effective mathematics teaching follows a clear structure".

Interview data demonstrated how mathematics-specific mentoring supported PSTs in practice. Tal described a supervising teacher who consistently connected practice to theory, and reflected that it was "fulfilling to see the practical and the theoretical kind of combine and merged". This approach enabled Tal to understand both the *how* and *why* of pedagogical decisions. Peri similarly described receiving mathematics-specific mentoring that expanded their pedagogical repertoire, such as using a trundle wheel to measure real spaces when exploring area, noting that they "would have never thought that was even a possibility". Several PSTs described supervisor feedback that directed attention to improving mathematical explanation. Dain reported encouragement to strengthen lesson summaries so students understood the conceptual purpose of lessons, while Lem received mentoring on how to articulate theorems clearly. Cece likewise highlighted mentoring conversations about sequencing content for mixed-ability classes, and how to anticipate student misconceptions.

PSTs noted that without mathematics-specific mentoring they felt unsure of how to develop practice, even with positive supervisory support. Limited opportunities to engage in pedagogical discussions resulted in a negative shift in PSTs' mindsets, with some noting "classroom management is more important than teaching mathematics". Without mathematics-specific mentoring, PSTs defaulted to replicating supervisors' pedagogy ("prac[ticum] students have a lot less autonomy…most of my lessons plans were catered towards my supervising teacher's usual pedagogy") and felt constrained in developing their competence ("I could not teach how I wanted", "you don't have much control over your own actions").

These findings highlight the importance of supervisor mentoring that focuses on sustained engagement with pedagogical decisions to develop PSTs' mathematical pedagogical content knowledge (Ball et al., 2008; Hudson, 2013; Shulman, 1987). Mathematics-specific mentoring additionally supports PSTs' competence by positioning mathematics teaching as learnable (i.e., a growth mindset; Dweck, 2006). As a result, such mentoring approaches position placements as developmental learning opportunities that centre students' mathematics learning.

Design Principle 3: Visible Belief in Learnability of Mathematics Teaching

PSTs' interpretations of instructional difficulty were mediated by supervisors' growth-oriented beliefs about the learnability of mathematics teaching. These messages shaped how PSTs interpreted challenges, influencing whether difficulties were seen as learning opportunities. With supervisor support, PSTs learned to persist through instructional difficulty, emphasising flexibility ("I have learnt that sometimes not all things will go the way you planned"), being prepared with multiple explanations ("you have to persist and try multiple explanations to help students understand"), and being adaptive based on students' needs ("I realised I must constantly try new things because students and days are all individual").

Interviews showed how growth-oriented interpretations of challenges were produced in situ. In Tal's first placement, their supervising teacher explicitly normalised the developmental and ongoing nature of becoming a competent teacher: "he told me that he didn't feel like a proper teacher until he was 4 or 5 years into the job" and that "on the drive home he would think and self-reflect on what could have gone differently". Tal's supervisor also communicated psychological safety around imperfection, telling PSTs to "focus on absorbing as much as we can", and emphasising that when they "stumbled…it's okay". Consistent with this positioning of teaching as learnable, Tal became more willing to seek challenge, noting they hoped future placements would be "completely different style[s] of school just so that I can learn a lot". While some placement accounts aligned with growth-oriented beliefs about teaching, others reinforced fixed narratives. Dain's case illustrated how placements could constrain PSTs' beliefs about what was possible in "real classrooms" when mentoring did not reframe these assumptions. Dain described viewing engaging or innovative pedagogy as "less possible" after placement, culminating in views such as "there's literally no way I can make polynomial division interesting". Other PSTs reported mathematics teaching as "very limiting and mundane" after placement. In these cases, "realism" discourses narrowed pedagogical possibilities, with challenges interpreted as confirmation that alternative approaches were not feasible. These contrasting trajectories were less about whether PSTs encountered challenging lessons (they all did), and more about how supervisors and faculty framed those lessons.

These placement accounts demonstrate that when supervisors framed struggle as expected and productive, PSTs were more likely to persist, experiment, and engage in reflective refinement of their practice (Nalipay et al., 2021). Growth mindsets act as a protective condition that sustains PST engagement and confidence, supporting their transition into a profession in which ongoing development is both necessary and inevitable (McCormack et al., 2006).

Design Principle 4: Relational Safety to Take Pedagogical Risks

PSTs' willingness to take pedagogical risks was connected to relational conditions within placement environments, particularly the extent to which they experienced belonging, trust, and psychological safety. One PST noted that "I'd be more likely to try things if I am in a safe environment…where I don't feel like I will be reprimanded if something goes wrong", highlighting how trust enabled risk-taking. Belonging was foundational for PSTs, with 25 of 27 survey responses referencing rapport with students and staff or feeling part of the school community as the most enjoyable components of placement.

Interviews illustrated how relational safety enabled pedagogical risk-taking in practice. Mich described their supervisor encouraging experimentation prior to giving feedback, allowing them to recognise limitations of lesson designs through experience. Similarly, Tal reported being encouraged to develop their own teaching style rather than imitate their supervisor, which supported experimentation with conceptual and hands-on approaches. Tal's supervisor told them "add your own personal touch…there's no point in you trying to mimic everything I do". Peri also reflected "my supervisor kept trying to stress…that not everything is perfect…don't let it get the better of you". Where supervisors modelled and encouraged pedagogical experimentation and a growth mindset towards teaching, PSTs reported greater willingness to trial new approaches. One PST noted that their supervisor "showed me new methods for certain topics as well as incorporating games into the lesson," strategies they intended to adopt in the future. Contrastingly, damaged relational trust and school environments that discouraged diverse pedagogical strategies had negative consequences for PSTs' willingness to experiment. For example, one PST reported "my supervising teacher constantly correcting me in front of students and peers damaged my confidence…I now am unsure about a career in teaching". Another noted "I would love to learn to do more inquiry tasks, but many teachers I have talked to were not in favour of them and found them difficult to run".

While design principle 3 focuses on how supervisors frame instructional challenges as part of the learnable nature of teaching, this design principle emphasises the relational conditions that enable PSTs to act on growth-oriented beliefs through pedagogical risk-taking (Hobson & Maxwell, 2017). When mistakes are treated as learning opportunities (Dweck, 2006), PSTs are more willing to trial alternative pedagogical approaches and refine their practice through reflection (Hudson, 2013; Schön, 1995; Shulman, 1987).

Practical Implications for Placement Design

Four key features (design principles) were identified in placement environments that supported preservice secondary mathematics teachers' flourishing identities. Taken together, these four design principles provide a framework for structuring secondary mathematics placements that support PST flourishing. The practical implications for different stakeholders (supervising teachers, placement schools, and ITE providers) are discussed below. Implications for PSTs are also addressed, as how PSTs engage within these environments matters given teacher identity is enacted through active participation in practice (Darragh, 2016).

Implications for Supervising Teachers

Supervising teachers play a critical role in creating placement environments that support PST flourishing. Mentoring should deliberately involve PSTs in the instructional decision-making processes of mathematics teaching (*design principle 1*) through a gradual release of responsibility approach involving co-planning opportunities where PSTs make bounded pedagogical decisions followed by reflective debriefs (Collet et al., 2025). This approach normalises, permits, and supports autonomous experimentation in mathematics teaching, all important in the agentic development of identity (Darragh, 2016), supporting PSTs' confidence (Byth, 2026). Supervisors should also prioritise mathematics-specific mentoring (*design principle 2*) that directs feedback towards instructional decisions shaping students' mathematical understanding, which supports the development of PSTs' pedagogical content knowledge (Ball et al., 2008). We suggest a protocol that focuses supervisory feedback on the mathematical goal of the lesson, how student thinking was facilitated, the mathematical representations used and their effectiveness, the mathematical explanations given and their clarity, how misconceptions were addressed, and how students' mathematical learning was evaluated. When feedback targets specific instructional moves, teaching becomes visible as a practice that can be refined through reflection and iteration, communicating the learnability of teaching (*design principle 3*) and reinforcing a growth orientation towards teaching practice (Dweck, 2006). Finally, supervisors can support pedagogical risk-taking by establishing relational safety (*design principle 4*), for example by welcoming PST questions, treating mistakes as learning opportunities, providing feedback respectfully, and meaningfully including PSTs in departmental conversations and routines (Beauchamp & Thomas, 2009).

Implications for Schools Hosting Placements

Schools hosting placements shape the structural conditions that enable PSTs to develop flourishing mathematics teacher identities. Satisfaction of the basic psychological needs in SDT depends on PSTs' interaction with environmental factors (Hobson & Maxwell, 2017), including whether they feel they belong to the school community as this impacts their perceived autonomy (Pendergast et al., 2020). To support structured autonomy (*design principle 1*), schools should avoid expectations that PSTs mimic supervisor's pedagogy and instead make space for PSTs to make autonomous decisions within syllabus-aligned scope and sequences. Allowing PSTs to access mathematics-specific mentoring (*design principle 2*) also requires schools to consider mentor selection carefully, prioritising teachers with strong pedagogical content knowledge (Hudson, 2013). Mentoring should ideally be recognised as a collective departmental responsibility, enabling PSTs to engage in richer professional conversations about mathematics

teaching and further develop their competence. Schools can further reinforce the learnability of mathematics teaching (*design principle 3*) by cultivating cultures in which observing, trialling approaches, revising lessons, and re-teaching are viewed as normal aspects of professional practice. This is particularly important in mathematics, where some student misconceptions are predictable, and instruction benefits from iterative refinement through ongoing professional learning (McCormack et al., 2006). Finally, fostering relational safety (*design principle 4*) requires PSTs to be treated as legitimate members of the mathematics teaching community, for example by including them in planning meetings and resource sharing where possible.

Implications for ITE Providers

ITE providers play an important role in preparing PSTs, supervisors, and schools for placement environments that support flourishing mathematics teacher identities. To support structured autonomy (*design principle 1*), PSTs should be prepared within ITE courses to make and justify instructional decisions in mathematics lessons. Developing this capacity requires explicit attention to pedagogical content knowledge within coursework (Ball et al., 2008; Shulman, 1987) and reflective practice skills (Schon, 1995). Ideally, PSTs should enter placements with an understanding that teaching develops through reflection and refinement (*design principle 3*). Preparing PSTs with reflective tools (Schön, 1995) that frame difficulty diagnostically can reinforce a growth-oriented view of teaching (Dweck, 2006). Mathematics-specific mentoring (*design principle 2*) requires ITE providers to support supervisors' capacity to lead productive pedagogical conversations by providing mathematics-specific briefing materials and feedback protocols. ITE providers should also encourage supervisors and schools to facilitate psychologically safe environments where PSTs engage in structured "risk cycles" (*design principle 4*), where they plan, teach, receive feedback, and re-teach lessons. Such cycles allow PSTs to refine pedagogical approaches through iterative practice.

Implications for Preservice Teachers

While placement environments and mentoring structures play a central role in supporting flourishing identities, PSTs are active participants in these environments and identity is enacted, not just supported (Darragh, 2016; Hobson & Maxwell, 2017). Therefore, it is important to articulate key agency-enabling moves that reinforce and complement the obligations of supervisors, schools, and ITE. PSTs can support their own development by engaging purposefully with the opportunities provided during placement. For example, when given opportunities to make autonomous instructional decisions (*design principle 1*), PSTs can articulate and justify choices and actively seek feedback on the effectiveness of these decisions. Engaging actively in mathematics-focused post-lesson conversations (*design principle 2*), for instance by asking targeted questions about student thinking, representations, or misconceptions etc., can further support PSTs in developing their competence. PSTs may also benefit from approaching moments of instructional difficulty as opportunities for learning (*design principle 3*), using feedback to reflectively plan future instructional moves. Finally, where relationally safe environments are established (*design principle 4*), PSTs can take bounded pedagogical risks, such as trialling alternative representations or discussion structures, and use subsequent feedback and debrief conversations to refine practice.

Conclusion

Placement conditions shape secondary mathematics PSTs' identities. These findings extend research on secondary mathematics teacher identity development by demonstrating that flourishing identities are cultivated through the design of placement environments, rather than existing as individually held dispositions. Consistent with SDT, secondary mathematics PSTs' sense of autonomy, competence, and relatedness (Ryan & Deci, 2017) were shaped through opportunities to participate meaningfully in instructional decision-making, receive

mathematics-specific mentoring, interpret instructional challenges as part of the learnable nature of teaching, and experience relationally safe environments that support pedagogical experimentation. When placements supported these conditions, PSTs were able to engage reflectively with their practice, develop confidence in their capacity to teach mathematics, and see themselves as legitimate members of the mathematics teaching community. These findings demonstrate the importance of intentionally designed placement environments that support the development of flourishing mathematics teachers.

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