# The Development of Preservice Mathematics Teachers' Professional Identities During a Practice-based Course

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Teacher education is expected to be a setting to develop preservice teachers' professional identities before they enter the teaching profession. Research, however, has shown that such development seldom occurs during teacher preparation. How to effectively do so thus requires further research. Given a newly revisited tendency toward practice-based teacher education, this mixed-method study examines the extent to which and how a practice-based course strengthens the professional identities of preservice teachers. Participants were preservice teachers (10 male, 20 female) majoring in mathematics in a double-degree teacher education program in Thailand. A Likert-type scale quantitatively measured three components (i.e., motivation, self-image, self-efficacy) as the proxies of participants' professional identities at the outset and conclusion of the course. Moreover, an open-ended questionnaire was used to collect qualitative data. Statistical analysis of the quantitative data indicated that participants significantly imagined themselves more clearly as mathematics teachers and were more confident in their ability to teach mathematics on completion of the course. Nonetheless, they were not significantly more motivated to become mathematics teachers. Content analysis of the qualitative data suggested that lesson design and teaching rehearsals within the course were attributed as beneficial experiences. These results support a stronger emphasis on practice-based teacher education for cultivating preservice teachers' professional identities.

**Keywords**: mixed-methods research • practice-based course • preservice teacher • professional identity • teacher education

## Introduction

If an individual chooses to enter a teacher education program, it is reasonable to anticipate that the individual will have a professional identity before graduating and working as a teacher (Beauchamp & Thomas, 2009). While a teacher's professional identity is variously defined in the literature (Beijaard et al., 2004), it refers generally to "an understanding of what it means to be a teacher, [not only] in one's own eye[s] but also in the eyes of others" (Sachs, 2005, p. 8). Previous research suggested that preservice teachers develop their professional identities during teacher education programs through practice-based experience more than theoretical learning (Jao et al., 2020). For example, within a 4-year program of mathematics teacher education, Arslan and Haser (2024) noted that preservice teachers in their third year of study did not feel ready as mathematics teachers after completing teaching-methods courses. However, after engaging in a school-based practicum in the fourth year, they were more confident about being mathematics teachers. These results highlighted the need to develop preservice teachers' professional identities during teacher education programs (Thomas & Beauchamp, 2011), particularly in coursework, which has been criticised as being overly theoretical (Moon, 2016).

In Thailand, where awareness of the development of preservice teachers' professional identities is largely absent, research on the topic is lacking. In line with Arslan and Haser's (2024) study, Prabjandee (2020) noted that preservice teachers majoring in English as a foreign language developed their professional identities fragmentedly over the course of a 5-year teacher education program because the curricular structure did not provide them with experience in developing professional identities. While no such research has been conducted on preservice teachers majoring in mathematics in Thailand, a

similar result can be expected, given that all teacher education programs have to follow the standards set by the Teacher's Council of Thailand (Inprasitha, 2019), which are more based on theory rather than practice (Rupavijetra & Rupavijetra, 2022). Despite this limitation, practice-based teacher education appears promising (Zeichner, 2012). As a core set of teaching practices is identified for preservice teachers to observe, learn, and rehearse (Forzani, 2014), Janssen et al. (2015) hypothesised that practice-based teacher education has the potential to support preservice teachers' professional identities. We thus initiated a practice-based course and examined its influence accordingly.

Regarding research on mathematics teachers' professional identities, whether pre- or in-service, Lutovac and Kaasila (2019) found, based on a review of 48 studies, that all studies applied a qualitative approach with most (38) involving around 10 participants or fewer. This tendency is also apparent when studies on preservice teachers intending to teach mathematics in secondary education in particular are considered (Losano & de Costa Trindade Cyrino, 2017). As such, Lutovac and Kaasila (2019) urged more mixed-methods studies on this topic to yield a more comprehensive understanding of the phenomenon. Moreover, because a mathematics teacher's professional identity contains aspects of both "self-in-mind" and "self-in-community" (van Zoest & Bohl, 2005, p. 332), a balance between studies on psychological and sociological aspects is important (Darragh, 2016). Given qualitative studies' focus on sociological aspects, Lutovac and Kaasila (2018) argued for more mixed-methods research into the psychological dimension to better support pre- and in-service teachers' professional identity development. Hence, the present study investigated the psychological development of preservice teachers' professional identities in a practice-based course using a mixed-methods approach.

# Literature Review

## *Teachers' Professional Identities*

As a construct, identity has its roots in socio-cultural theories (Lave & Wenger, 1991), which assert that individuals gradually develop a certain kind of identity as they increasingly participate in a particular community of practice (Wenger, 1998). In such a context, an identity can be defined as "being recognized as a certain kind of person" (Gee, 2000, p. 100). Given that individuals can simultaneously participate in various communities of practice throughout their lives (Wenger, 1998), they can have multiple identities at the same time (Gee, 2000). As such, individuals' identities can also be referred to as a collection of stories or "narratives about [themselves] that are reifying, endorsable, and significant" (Sfard & Prusak, 2005, p. 16). When the teaching profession is considered a community of practice, an individual can develop professional identities regarding becoming and being a teacher as they participate in the teaching profession (Beauchamp & Thomas, 2011). Although an individual may have begun to develop a professional identity as a teacher in childhood, a teacher education program can be considered the ideal starting point for creating preservice teachers' awareness of their existing identities and fostering further their professional identities (Beauchamp & Thomas, 2009).

Despite the lack of consensus in definition, a teacher's professional identity can be described in terms of four characteristics: (a) its development is an ongoing process, as the teacher continuously interprets their experiences; (b) it implies the relationship between teacher and context, in physical, psychological, historical and sociocultural senses; (c) it consists of sub-identities related to the teacher's biological traits, institution, discourse and affinity, which interact and intersect; and (d) it involves agency, in that the teacher must be active in constructing a designated identity (Beijaard et al., 2004). As such, Enyedy et al. (2006) described a teacher's professional identity as lying at "the intersection between one's personal history and individual psychology on the one hand and one's cultural history and community of practice on the other hand" (p. 71). Specifically in the context of mathematics teacher education, Losano et al. (2018) defined a teacher's professional identity as

> a set of self-understandings related to ways of being, living, and projecting into the teaching profession, … [which] are not only personally or subjectively constructed by the teacher … [but also] socially and historically constructed with other participants of the world of teaching. (p. 291)

The nature of a teacher's professional identity can be increasingly complex when considering the subject they teach. Because teachers not only participate in the community of teaching practice but also engage in the community of disciplinary practice (Polizzi et al., 2021), their professional identities are more or less discipline specific (Thompson, 2023). This disciplinary specificity emerges as their discipline and teaching identities intertwine (Galanti & Holincheck, 2022). This is also the case for the professional identities of those who teach mathematics (Cribbs & Utley, 2024), whose degree of disciplinary specificity depends on the individual. Mathematical identities may not be strong in elementary teachers who teach mathematics (Crisan & Rodd, 2017) and must be developed further (Gomez, 2018). The mathematical identities of mathematics specialists who teach at the secondary level may dominate their teaching identities (van Putten et al., 2014). Despite the varying degree of discipline specificity across individuals, in teacher education programs and classrooms, pre- and in-service teachers' teaching identities likely contribute more significantly to their overall professional identities than their discipline identities (Groontenboer & Ballantyne, 2010; Holincheck & Galanti, 2023).

The multi-faceted nature of a mathematics teacher's professional identity leads to different ways to measure and thereby develop it. According to Darragh (2016), this construct can be empirically investigated through psychological and sociological stances, with each respectively focusing on the "self-in-mind" and "self-in-community" aspects (van Zoest & Bohl, 2005). In Lutovac and Kaasila's (2019) review, most studies were qualitative with a socio-cultural focus, which, according to Lutovac and Kaasila (2018), is at odds with the core concept of identity itself. To fill this gap in the literature, several attempts have been made to develop quantitative instruments to measure the psychological side of teachers' professional identities (Hanna et al., 2019). For example, Hanna et al.'s (2020) scale measured preservice teachers' professional identities in elementary education, whereas Willis et al.'s (2023) questionnaire measured the professional identities of in-service teachers who teach mathematics in elementary and secondary grades. Recently, Cribbs and Utley's (2024) survey focused on in-service teachers' professional identities as mathematics teachers at elementary levels. These quantitative instruments, however, differ in terms of intended target, framework and psychometric properties.

Compared to other instruments, Hanna et al.'s (2020) scale is more appropriate for the current study. It was designed for preservice teachers and was based on a comprehensive review of existing instruments (Hanna et al., 2019). This scale includes four components: (a) motivation, (b) self-image, (c) task perception and (d) self-efficacy. These components are based on Kelchtermans' (2009) conceptualisation, where motivation reflects the motives or drives that make preservice teachers choose to become teachers; self-image represents the way preservice teachers typify themselves as teachers based on their self-perception and what others mirror back to them; and task perception encompasses preservice teachers' ideas of what constitutes their tasks and duties as teachers in order to do a good job. Hanna et al. (2020), however, replaced self-esteem, which relates to the appreciation of actual job performance, with self-efficacy to make the scale more relevant to preservice teachers. Based on Bandura (1977), self-efficacy involves preservice teachers' beliefs in their capability to organise and perform their daily teaching activities effectively. Although this scale does not specify a discipline, it can be purposively adapted for discipline-specific use (Ladachart et al., 2024).

Regardless of discipline, Thomas and Beauchamp (2007) urged that research shift from simply exploring pre- and in-service teachers' professional identities to investigating the developmental process of these identities, particularly within teacher education programs. This call for research is especially relevant to mathematics teacher education, where research is largely qualitative (Lutovac & Kaasila, 2019). The literature in this area has remained mostly exploratory (Lutovac & Kaasila, 2018), with some exceptions focusing on developmental aims (Gibbons et al., 2018). Addressing this gap, however, becomes increasingly feasible with the development of quantitative instruments for measuring individuals' professional identities as mathematics teachers (Cribbs & Utley, 2024; Willis et al., 2023). Such instruments make it possible to quantitatively compare preservice mathematics teachers' professional identities before and after promising interventions. To contribute to this effort, the present study employed mixed-methods research to investigate whether and how preservice teachers develop

their professional identities as mathematics teachers in a practice-based course that emphasises lesson design and teaching rehearsals.

## *Practice-based Teacher Education*

Based on an analysis of teacher education programs worldwide, Moon (2016) found that the curricula tend to be overly theoretical and lack practical elements. The traditional model of teacher education expects preservice teachers to learn theoretical knowledge before applying it in practice, which results in a gap between theory and practice in learning to teach (Korthagen, 2010). In response to this limitation, many countries are seeking a better balance between theory and practice in teacher education programs (Darling-Hammond, 2017). Practice-based teacher education (Forzani, 2014) is a promising approach that considers teaching a practice that integrates cognition, craft, and affect (Grossman & McDonald, 2008). Accordingly, engaging in teaching practice is central to learning to teach (Zeichner, 2012). Taking this approach, the aspects of teaching practice that are essential to the work of teaching—referred to as "core practices" (McDonald et al., 2013)—are identified, decomposed, and structured for preservice teachers to practice and learn in progressive and systematic ways (Matsumoto-Royo & Ramirez-Montoya, 2021). Although there is no consensus on what constitutes core practices, Grossman et al. (2009, p. 277) suggested the following characteristics:

1. Practices that occur with high frequency in teaching.
2. Practices that novices can enact in classrooms across different curricula or instructional approaches.
3. Practices that novices can actually begin to master.
4. Practices that allow novices to learn more about students and about teaching.
5. Practices that preserve the integrity and complexity of teaching.
6. Practices that are research based and have the potential to improve student achievement.

In their effort to enact practice-based teacher education, where preservice teachers learn a certain kind of teaching practice (e.g., eliciting student thinking), McDonald et al. (2013) proposed a pedagogical model with four stages. First, teacher educators introduce preservice teachers to this practice through several methods, such as modelling, video analysis, and case analysis, so that preservice teachers can develop a vision of the activity wherein the practice is embedded. Second, with the provision of practice, preservice teachers plan and rehearse the practice within those lessons; in doing so, preservice teachers and teacher educators can together debrief after rehearsals and revise lesson plans. Third, as preservice teachers rehearse and become familiar with the practice embedded in the lessons, they enact the lessons with students, through which teacher educators support preservice teachers by engaging in real-time coaching or by co-teaching to provide in-the-moment modelling. Fourth, after implementing the lessons, preservice teachers analyse and reflect on the enactment of the practice with teacher educators and peers. This sequential process can begin at any stage and be flexibly conducted in various locations, whether university or school.

Thailand's teacher education has undergone several transformations, for example, from degree- to standards-based (Thongthew, 2014). Despite these transformations, it still focuses more on theory than practice (Rupavijetra & Rupavijetra, 2022) and thus shares the international tendency towards theory-oriented teacher education (Moon, 2016). However, the proportions of theoretical and practical elements in Thailand's teacher education programs cannot be directly compared with those in other countries due to domestic variations and a lack of information. In this regard, the Teacher's Council of Thailand is responsible for setting the standard of knowledge and experience for all teacher education programs (Inprasitha, 2019) as a requirement for issuing teaching licenses to those who will become teachers (Siribanpitak, 2018). The expectation is universities design their teacher education programs on that standard. According to Thongthew (2014), preservice teachers must complete 160 credits, categorised into four groups: 30 credits in general education, 50 credits in pedagogy education, 74 credits in subject education and 6 credits for elective education. Owing to a top-down policy, the

duration of teacher education programs was reduced from five to four years in 2019 (Rupavijetra & Rupavijetra, 2022).

While not explicitly stated, what emerges alongside the last transformation is a greater emphasis on practice-based teacher education. Previously, in 5-year programs of teacher education, preservice teachers completed all university-based courses in the first to fourth years before engaging in a year-long in-school practicum in the fifth year. Now, in 4-year teacher education programs, preservice teachers have three weeks between semesters in the first and second years to visit schools and observe in-service teachers' practices, respectively. They also have four weeks at school to work as teaching assistants of in-service teachers between semester in the third year. This school-based experience is said to support preservice teachers in integrating knowledge gained from many of the courses taken to teaching practice at the schools (Rupavijetra & Rupavijetra, 2022), in addition to preventing the "reality shock" that might occur when preservice teachers transition from the theoretical to the practical world in the fourth year (Kim & Cho, 2014). With this increase in practice-based experience at school, preservice teachers can perceive the authenticity of what they study during theory-oriented university courses.

Despite research showing a 5-year teacher education program not being effective in facilitating preservice teachers' professional identities (Prabjandee, 2020), studies on the outcome of 4-year programs of teacher education in Thailand remain absent (Rupavijetra & Rupavijetra, 2022), particularly with regard to preservice teachers' professional identities. The recent turn toward practice-based teacher education holds promise that preservice teachers will better develop their professional identities (Janssen et al., 2015). As Sutherland and Markauskaite (2012) demonstrated, when preservice teachers perceive experience gained during teacher education programs as authentic, their professional identities develop. To increase the authenticity of such experience, Iverson et al. (2008) suggested that instructional tasks in the coursework of teacher education programs should reflect the routine of being a teacher, be intended for students as a prospective audience, promote knowledge of practices, involve self-reflection and serve formative purposes, all of which align with the premise of practice-based teacher education. Specifically, as Lampert et al. (2013) demonstrated, teaching rehearsal has the potential to develop preservice teachers' professional identities.

## Research Questions

Given the potential of practice-based teacher education in supporting preservice teachers' professional identities, the first author transformed the *Basics of Learning Management* course into a practice-based one. Due to an institutional policy, this course was traditionally designed by a principal instructor and taught accordingly by several instructors to preservice teachers with various majors (e.g., mathematics, Thai language, social studies). It aimed to promote preservice teachers' basic understandings of curriculum development, instructional approaches and an environment suitable for learning. As such, this course was theory oriented. Although the course syllabus included opportunities for preservice teachers to use their theoretical understandings in designing learning activities and writing lesson plans, the latter was normally left as homework, owing to the inadequate time for and demanding content of the former. In response to this limitation, the first author made the course more practice based. Doing so aligned with Ebby (2000), who argued that instead of a linear process from theory to practice, learning to teach should be a bi-directional process where preservice teachers learn theory and practice reciprocally. Within this effort, two research questions were posed:

*(a) To what extent and in what respect does a practice-based course promote preservice teachers' professional identities?*

*(b) What experience within a practice-based course do preservice teachers attribute to contributing to their professional identities?*

# Research Methods

This study employed mixed-methods research (Johnson et al., 2007), with quantitative and qualitative approaches integrated to investigate a single phenomenon (i.e., the influence of a practice-based course on preservice teachers' professional identities). The study has an explanatory design (Creswell & Creswell, 2018), with qualitative data were used to explain quantitative findings. Specifically, a Likert-type questionnaire was administered to collect quantitative data regarding preservice teachers' professional identities before and after a practice-based course to address the first research question. An open-ended questionnaire was subsequently utilised to gather qualitative data regarding what experiences during the practice-based course might influence preservice teachers' professional identities to answer the second research question. Additionally, this study incorporated an embedded design (Creswell & Plano Clark, 2011) because the qualitative data were collected before the quantitative findings were known. With both types of data, this study has the potential to provide a better understanding of whether and how a practice-based course affected preservice teachers' professional identities than using one type of data alone. Details of the research are presented as follows.

## *Context*

This study was situated in a 4-year undergraduate teacher education program at a university in northern Thailand that recruits those who have completed secondary education. When entering the program, preservice teachers must select a major at the outset and are able to change it later, if required. The double-degree program requires preservice teachers to simultaneously pursue two bachelor's degrees, one in a subject-matter major and another in education. As such, each preservice teacher can be placed somewhere on a continuum based on their identification with the teaching profession. Some may enter the program with strong motivation to become a teacher—thus, being a teacher is the only option for them. Some may not be interested in becoming a teacher yet choose to gain a bachelor's degree in education as a fallback for various reasons (e.g., job prospects). For preservice teachers with a major in mathematics, the program requires them to complete 152 credits, categorised into three groups: (a) general subjects taught by the university's Division of Educational Services (39 credits), (b) disciplinary subjects taught by the Faculty of Science (77 credits) and (c) educational subjects taught by the School of Education (36 credits), as set by the Teachers' Council of Thailand.

## *Course*

Making a course practice-based does not mean that theory is unnecessary. Rather, theory is central to informing teaching practice and enabling reflection on it (Newman, 2022). As such, the course began by introducing preservice teachers to mathematical content and process in the national core curriculum standards (Bureau of Academic Affairs and Educational Standards, 2017). Preservice teachers were then introduced to the constructivist nature of learning (Simon, 1994), which followed an open-ended approach to teaching mathematics that has been nationally promoted in the country (Inprasitha, 2019). Preservice teachers then learned how to write a lesson plan and selected a topic to create one. Outside of class time, individual scaffolding was provided to guide preservice teachers' lessons toward a constructivist approach. Nonetheless, final decisions regarding how to teach depended on the individual. Subsequently, preservice teachers took turns rehearsing their planned lessons, while the remaining classmates acted as students. Self-reflection on each rehearsal was immediately shared in class. The aim of the teaching rehearsals was to increase self-efficacy in teaching mathematics via mastery experience, vicarious experience, verbal persuasion, and emotional arousal (Bandura, 1977).

## *Participants*

According to the Teacher's Council of Thailand, every subject teacher education program coursework should ideally be organised within a class of 30 preservice teachers. Thus, to serve all 102 preservice

teachers majoring in mathematics in the second-year cohort, the course was divided into three sections taught by different instructors. Thirty preservice teachers, 10 male (M) and 20 female (F), registered on the course taught by the first author. These preservice teachers were informed at the outset that this section was different from the other two in that it focused on teaching rehearsals as a primary activity for professional learning, while mid-term and final examinations, as described in the course's syllabus, remained. Despite a chance to change to a different section within the first two weeks of the semester, these preservice teachers gave consent to participate in the study after being made aware of the research objectives. The participants engaged in the course once a week for 3–4 hours in the second semester of their second year. Prior to this, they had completed four courses in education: *Introduction to the Teaching Profession*, *Educational Psychology*, and *Economic, Social, and Technological Influences on Education* in their first year. They had also completed the *Educational Technology* course in the previous semester.

## *Data Collection*

Hanna et al.'s (2020) 5-point scale was used as the quantitative instrument. The scale was designed to measure four components of preservice teachers' professional identities: motivation, self-image, self-efficacy and task perception. However, as task perception covers a wide range of tasks, it was shown to be 'the weakest link' with preservice teachers' professional identities (Hanna, 2020, p. 121) and was thus excluded from this study. As such, seven items for each component of the original scale were translated from English to Thai. Given that the original scale focuses on preservice elementary teachers, the term "elementary" was replaced by "mathematics." Three Thai educators examined the scale's validity before it was piloted with 17 preservice biology teachers at another university (Pulsawad et al., 2025), which resulted in acceptable reliability as indicated by Cronbach's alphas (see Appendix). The participants completed this scale online at the outset and conclusion of the course. Moreover, at the end of the course, they were asked to write responses to open-ended questions in a paper-based format regarding whether the experiences—and if so, which ones—influenced their professional identities by component. They also had the opportunity to write other comments.

## *Data Analysis*

Quantitative data were analysed using JASP software (Goss-Sampson, 2020). The first step involved rechecking the reliability of the scale, which yielded Cronbach's alphas greater than 0.70 for motivation, self-image and self-efficacy both before (0.80, 0.87 and 0.87, respectively) and after (0.90, 0.83 and 0.87, respectively) the course. The means of each component at the outset and conclusion of the course were then calculated along with standard deviations. Comparisons between each pair of respective means were subsequently conducted. In this regard, a paired-samples *t*-test was used because the number of participants reached a threshold of 30 (Wilson Van Voorhis & Morgan, 2007). Moreover, according to Shapiro-Wilk tests, all sets of pre- and post-measurement data were normally distributed ($p > .05$). When a significant difference was detected ($p < .05$), Cohen's *d* was calculated as the effect size. Once the quantitative analysis was done, qualitative data were analysed by repeatedly reading participants' written responses to identify themes elaborating on and explaining the quantitative findings. The tentative themes initially developed by the first author were examined by the second author. Both authors discussed all discrepancies until they reached a consensus.

# Research Results

## *Quantitative Findings*

Based on descriptive analysis, the participants scored almost equally on each component of professional identity at the outset of the course. Specifically, out of five, their mean on motivation ranked first, at 3.89 ($SD$ = 0.50), followed by their means on self-image, at 3.81 ($SD$ = 0.62), and self-efficacy, at 3.80

(*SD* = 0.57). At the end of the course, their means on all three components had increased. In particular, their mean on self-image ranked first, at 4.00 (*SD* = 0.55), followed by their means on motivation, at 3.98 (*SD* = 0.58), and self-efficacy, at 3.93 (*SD* = 0.49). Figure 1 illustrates these tendencies. In this regard, a paired-samples *t*-test indicated that the improvements in self-image ($t$ (29) = 1.806, $p$ = 0.041) and self-efficacy ($t$ (29) = 1.770, $p$ = 0.044) were significant, with effect sizes of 0.33 and 0.32, respectively. These values indicate small-to-medium effect sizes. In contrast, the improvement in motivation was insignificant ($t$ (29) = 0.981, $p$ = 0.167). These quantitative findings suggest that the course helped preservice teachers more clearly see themselves as teachers, as well as believe more in their own abilities to teach, although it did not help them become more motivated to become teachers. These quantitative findings were supported by the qualitative results, as described in the next section.

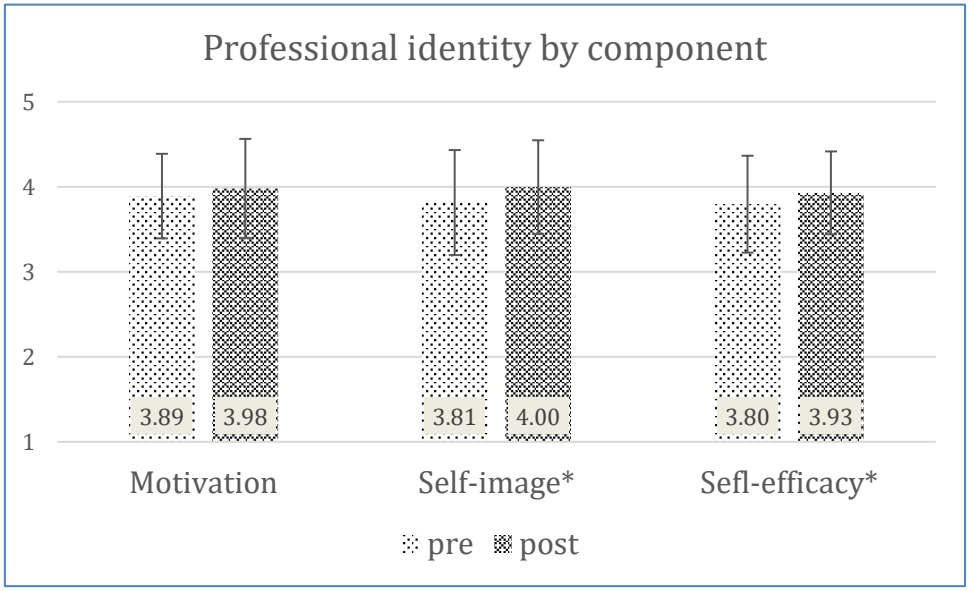


*Figure 1.* Participants' professional identities by component.

## *Qualitative Results*

The analysis of qualitative data confirmed the quantitative findings. Of the 29 participants who returned the open-ended questionnaire (one did not), 25 (86.21%) reported seeing themselves as teachers more clearly, with only four (13.79%) indicating no or only slightly clearer images of themselves as teachers. For those who more imagined themselves as teachers, most ($n$ = 15, 60.00%) attributed this to the experiences of preparing lessons and/or teaching rehearsals. For example, F14 noted that her self-image as a teacher had become clearer because she "got to try teaching rehearsal [and] writing a [lesson] plan like being a real teacher." Similarly, F20 expressed, "As I had taught, [this experience] made me see friends as students and see myself as a real teacher." In this regard, some participants added that teaching rehearsals made them "enjoy" (F11), "dare to do and say" (F18) and "know whether [they] can teach" (F16). It was, however, the self-evaluation and awareness during teaching rehearsals that caused some participants to not see themselves as teachers more clearly. For example, F15 confessed that her self-image as a teacher was "not so clear because, while teaching rehearsal, [I] still spoke not quite understandably. [My] communication of the content wasn't so good."

In addition to improvements in participants' self-images as teachers, the qualitative results confirmed improvements in their self-efficacy to teach. Of the 29 participants who contributed to the qualitative data, 22 (75.86%) wrote that they believed more in their abilities to teach, with seven (24.14%) indicating no or little improvement in this regard. For those who were more self-efficacious in teaching, most ($n$ = 9, 40.91%) attributed the teaching rehearsals as influential; this experience afforded them

opportunities to "do new things" (F13) related to teaching, such as "managing a classroom, talking with children and reviewing content" (F17), which made them "more confident" to teach (F20), particularly when "unexpected events [that required them to] solve immediate problems" occurred (F26). Moreover, some participants (7, 31.82%) attributed their improvements to "friend's responses [to their teaching rehearsals, which] were rather positive" (M1), as well as "the instructor's comments [which were] really applicable" (F10) and useful "for self-development" (M5). For those with no or little increase in self-efficacy to teach, all seemed unsatisfied with their own teaching rehearsals. For example, F12 reported her feeling that "I do not teach well yet and need to develop more."

When compared to the number of participants showing improvements in self-image as a teacher and self-efficacy in teaching, a smaller number reported improvements in motivation to be teachers. Of the 29 participants who responded to the open-ended questions, 20 (68.97%) mentioned being more motivated to be teachers, with nine (31.03%) indicating no or little increase in this regard. For those with increased motivation, most (13, 65.00%) attributed it to teaching rehearsals, which made them learn to teach, particularly in different ways (e.g., open-ended, constructivist approaches). For example, F28 noted that "I got a lot of advice. From one who did not know how to teach, I saw more approaches to teaching and learning." In a similar vein, F25 reported that "I have learned many things in this course and have written a [lesson] plan that I have never done." They also added that learning to teach made them "enjoy" (M1) and "like" (F17) teaching. Some expressed that they "want to teach students" (F21) and "give knowledge to children" (F29). Among those with no or little improvement in motivation to be a teacher, some were concerned with having "little experience" (M7) or "not [liking] writing a lesson plan" (M11), while F27 perceived teaching as challenging and demanding work:

> *I feel that I don't want to be a teacher anymore. I feel that* [mathematics] *is a rather difficult one to teach and make students truly understand. Not every student will understand what I teach. In addition, learning indicators and learning units in mathematics have nothing so clear. We have to do a lot* [to prepare a lesson] *ourselves. It makes* [it] *feel even more difficult.*

## Discussion

Through a Likert-type scale and an open-ended questionnaire, this mixed-methods study examined the professional identities of preservice mathematics teachers (10 male, 20 female) before and after a practice-based course in a Thai context. The findings reveal that, over a semester-long course, the participants significantly developed their professional identities in terms of self-image as a teacher and self-efficacy in teaching. Although their motivation to become teachers also increased, this development was not significant. This study's findings are more positive than the results reported in Prabjandee's (2020) study, which was also conducted in Thailand. Specifically, he found that first- to fourth-year preservice teachers majoring in English as a foreign language seldom differed in their professional identities during the coursework of a 5-year teacher education program. Although his study did not track the same group of preservice teachers longitudinally, it suggests that traditional teacher education program coursework is ineffective in fostering preservice teachers' professional identities. The present study has a shorter timeframe than this prior research. Thus, the experience preservice teachers gain during the coursework seems more crucial than its duration.

The findings of the present study align with prior studies outside Thailand. For example, Arslan and Haser (2024) found that preservice teachers tend to develop their professional identities when engaging in teaching-methods courses and practicum. Given that the experiences in teaching-methods courses and practicum are more practice oriented than those in the coursework, the development of preservice teachers' professional identities likely resulted from practice-based experience. Similarly, Jao et al. (2020) found that while coursework serves as a good foundation for preservice teachers, teaching-methods courses and practicum afford experiences that allow them to grow most as a teacher. This claim is supported by the qualitative data in the present study, as participants identified teaching rehearsals and preparing lessons as key experiences contributing to the development of their professional identities. Specifically, Lampert et al. (2013) reported that teaching rehearsal in a teaching-methods course helps

preservice teachers learn to teach while developing their professional identities. Aligning with these non-Thai studies, the present work supports the premise of practice-based teacher education in fostering preservice teachers' professional identities.

The improvements to preservice teachers' professional identities in this study can be discussed in terms of the authenticity of the practice-based course. In the context of engineering education, Ju and Zhu (2023) observed that practice-oriented approaches to learning (e.g., engagement in an authentic project) can facilitate novices' professional identities because these experiences are perceived as relevant to their prospective profession. This is also the case in teacher education, where Sutherland and Markauskaite (2012) noted that preservice teachers develop their professional identities when they perceive their learning experiences as authentic. In this study, preparing lessons and teaching rehearsals may be seen as authentic by preservice teachers; these activities are normal duties of teachers, intend for students as a prospective audience, promote practical knowledge for teaching, provoke self-reflection and serve formative purposes for future professional development (Iverson et al., 2008). In the perspectives of preservice teachers, such authenticity may be absent in the theoretical coursework of teacher education (Rupavijetra & Rupavijetra, 2022). In such coursework, preservice teachers are limited in the ability to strengthen their professional identities (Prabjandee, 2020).

In terms of a focus on each component of professional identity, the preservice teachers showed a tendency to imagine themselves more clearly as teachers after the practice-based course. Most identified preparing lessons and teaching rehearsals as influential experiences. According to Kelchtermans (2009), although self-image as a teacher is based on self-perception, it is strongly influenced by the way one is perceived by others. In preparing lessons and teaching rehearsals, preservice teachers had many opportunities to perceive themselves as teachers (e.g., reviewing content, designing activities) and be perceived thusly by their classmates, who assumed the roles of students (e.g., presenting content, interacting with students). As Lampert et al. (2013) noted, teaching rehearsals allow preservice teachers not only to attend to aspects of practice but also to attend to the variations of the practice as it relates to students. With opportunities to teach in front of a classroom, preservice teachers were able to project themselves as teachers more clearly in the practice-based course. In contrast, the lack of such opportunities in the theory-oriented courses seems to limit preservice teachers' abilities to develop their self-images as teachers.

Along with the development of self-images as teachers, a tendency exists for preservice teachers to develop their self-efficacy in teaching. Based on Bandura's (1982) theory, mastery experience is the most influential source of self-efficacy. In other words, individuals can develop their self-efficacy for a task mainly through gaining experience in that task. In this study, while preservice teachers may have at first worried about teaching their classmates, they identified teaching rehearsals as a crucial experience that enhanced their self-efficacy to teach. Additionally, vicarious experience is another source of self-efficacy (Bandura, 1977). Specifically, individuals can develop this for a task if they observe the success of others, particularly those deemed similar to them. In this regard, teaching rehearsals provided a context where preservice teachers, while assuming the roles of students, observed their classmates and succeeded in playing the roles of teachers. Moreover, the positive feedback from their classmates and the instructor's encouraging comments served as verbal persuasion, an additional source of self-efficacy (Bandura, 1982). These sources, which were present in the practice-based course, collectively reinforced preservice teachers' self-efficacy in teaching.

When compared to their development of self-images as teachers and self-efficacy in teaching, preservice teachers' motivation to be teachers was developed to a lesser degree. This result can be discussed by considering this study's contextual conditions. This study was undertaken under a double-degree teacher education program; not all participants wanted to become teachers. By studying in the teacher education program, being a teacher may at best be a fallback career for some (Fokkens-Bruinsma & Canrinus, 2014). For example, F19 expressed, “In this life, I don't want to be a teacher that much. Yet, studying [in a teacher education program] until now makes me feel more like teaching a little bit.” Research has shown that numerous factors can influence an individual's motivation to become a teacher, such as the desire to contribute to society, love of the subject and work–life balance (Whiteford

et al., 2021). Despite clearer images of themselves as teachers and increased self-efficacy in teaching, some participants (in their second year of the program) might still question whether to become teachers. However, it is promising that strong professional identities in preservice teachers' correlate with their decision to opt for the teaching profession (Horvath et al., 2018).

## Implications

This study shows that preservice teachers' professional identities can be developed in a practice-based course and thus provides several implications for teacher education. First, it challenges the "theory into practice" model of teacher education (Korthagen, 2010), which is still prevalent internationally (Moon, 2016). This implication does not mean that theoretical dimensions in teacher education should be eliminated but suggests that a balance between theory and practice must be reestablished (Darling-Hammond, 2017). Particularly in Thailand, where teacher education coursework focuses on theory rather than practice (Rupavijetra & Rupavijetra, 2022), practical dimensions must be increased. Instead of presenting a wide range of theories and expecting preservice teachers to later select and apply those theories by themselves, teacher educators should critically select only the theories necessary for their courses and introduce these to preservice teachers as a framework for engaging in relevant practice. With more emphasis on practice, preservice teachers can perceive the authenticity of courses and strengthen their professional identities (Sutherland & Markauskaite, 2012). This implication can support the need to move toward identity-focused teacher education (Lerman, 2001).

Second, given that the importance of developing preservice teachers' professional identities is still unrecognised in many circumstances (Beauchamp & Thomas, 2009), including Thailand (Prabjandee, 2020), this study highlights teaching rehearsals as a pedagogical approach for this purpose (Lampert et al., 2013). Teaching rehearsals are considered by preservice teachers as experiences beneficial for the development of their professional identities, particularly in terms of self-image and self-efficacy. Thus, opportunities for preservice teachers to engage in teaching rehearsals should be increased in teacher education programs. According to McDonald et al. (2013), teaching rehearsals can be organised in various settings, such as in teaching-methods courses at universities, teaching-methods courses at schools or authentic classrooms at schools. In Thailand, where preservice teachers are now expected to occasionally visit schools between semesters during each academic year (Rupavijetra & Rupavijetra, 2022), teaching rehearsals can be progressively distributed across these occasions at school, in addition to a teaching-methods course at university. Preservice teachers can concurrently learn theory and practice through teaching rehearsals in these various settings.

Third, for teaching rehearsals to be effective in promoting preservice teachers' professional identities, support from teacher educators is crucial (Lampert et al., 2013). In this regard, teacher educators can support preservice teachers in several ways (McDonald et al., 2013). For example, before teaching rehearsals, teacher educators should collaborate with or give advice to preservice teachers about how to prepare lessons in ways consistent with the relevant theories previously introduced to them. Teacher educators can also assist, coach or model preservice teachers while they are engaging in teaching rehearsals. Depending on the situation, teacher educators can decide whether to intervene in teaching rehearsals to explicitly highlight critical moments that provoke preservice teachers' observations of and reflections "in" their actions. After teaching rehearsals, teacher educators can share their own reflections "on" teaching rehearsals and encourage such reflection among preservice teachers, from both those who teach and those who play the roles of students. In addition, teacher educators should create a psycho-social environment that is productive for preservice teachers who are learning to teach and enables them to be recognised as "real" teachers.

## Limitations

This study has several limitations that must be noted. First, its participants comprised a group of preservice teachers attending a course in a teacher education program at a university in northern

Thailand. They may have characteristics different from those of preservice teachers elsewhere. The results should thus not be generalised without critically considering their contextual uniqueness (Gobo, 2008). Second, preservice teachers' professional identities were mainly framed from a psychological perspective in terms of motivation, self-image and self-efficacy (Hanna et al., 2020). Thus, this study did not fully capture other dimensions of preservice teachers' professional identities (Beijaard et al., 2004). For example, F26 expressed that "I used to really want to be a teacher in this subject, but encountered an event that made me feel hesitant until this day." This expression reflects the narrative nature of preservice teachers' professional identities (Sfard & Prusak, 2005), which was not directly measured in this study. Third, this study also ignored other identities (e.g., gender) of preservice teachers (Gee, 2000). Despite these limitations, this study offers insights into how a practice-based course fosters preservice teachers' professional identities in mathematics teacher education.

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## *Ethical approval*

Ethical approval for the research was granted by the University of Phayao's Human Research Ethics Committee on Humanities and Social Sciences under the code HREC-UP-HSS 2.2/143/67, and Informed consent was given by all participants for their data to be published.

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## *Competing interests*

The authors declare there are no competing interests.

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# Appendix

*Quantitative and qualitative measurements*

| Type of measurement | Component (Cronbach's alpha) | Items/questions |
|---|---|---|
| Quantitative instrument | Motivation (0.78) | I want to become a mathematics teacher because I like teaching. |
| | | I want to become a mathematics teacher because I like being a mathematics teacher. |
| | | I want to become a mathematics teacher because like teaching mathematics. |
| | | I want to become a mathematics teacher because I want to have my own mathematics class. |
| | | I want to become a mathematics teacher because I want a job that involves working with children who are interested in mathematics. |
| | | I want to become a mathematics teacher because I like working about mathematics in a school. |
| | | I want to become a mathematics because I like to work with children who are interested in mathematics. |
| | Self-image (0.80) | I see myself as a mathematics teacher. |
| | | I would miss teaching mathematics if I stopped the teacher training program. |
| | | I truly enjoy teaching mathematics. |
| | | I actively have looked for opportunities to work in mathematics education. |
| | | I frequently talk to peers about teaching mathematics. |
| | | I feel part of a community of mathematics teachers. |
| | | I think it is valuable to be able to talk about mathematics education. |
| | Self-efficacy (0.76) | I can implement alternative strategies in my mathematics classroom. |
| | | I can gauge students' learning of mathematics that I have taught. |
| | | I can adjust my mathematics lessons appropriately. |
| | | I can provide appropriate challenges for students who are very capable of mathematics. |
| | | I can help my students value learning of mathematics. |
| | | I can establish routines to keep mathematics learning activities smoothly. |
| | | I can get students to believe that can do well in learning mathematics. |
| Qualitative instrument | Motivation | Have the experiences in this course made you more motivated to be a teacher? If so, how? |
| | Self-image | Have the experiences in this course helped you imagine yourself as a teacher more clearly? If so, how? |
| | Self-efficacy | Have the experiences in this course made you believe more in your ability to be a mathematics teacher? If so, how? |
| | Additional comments | Do you have other opinions or feelings to express about this course or the instructor? |