Pre-Service Teachers' Self-efficacy as Future Mathematics Teachers in a Second Language Classroom

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Abstract

This study contributes to the field of research on teacher self-efficacy by investigating a group of multilingual pre-service teachers' perceptions of self-efficacy in Norwegian mathematics classrooms. In recent years, several quantitative studies exploring teacher self-efficacy have been conducted, but according to Xenofontos and Andrews (2020) there are few qualitative studies addressing conceptualizations of self-efficacy across various contexts. Furthermore, the cultural and language dimensions related to self-efficacy are usually not addressed. Pertaining to this group of multilingual pre-service teachers, all enrolled in the multilingual teacher preparation program at the University of Agder, we found that it was not sufficient for them to focus solely on acquiring mathematical knowledge or developing their mathematics teaching skills. They also needed to navigate a different classroom culture and a language that is not their first language. As a result, this study contributes crucial insights to complement the theory of teacher self-efficacy.

Keywords: Mathematics education, pre-service teachers, multilingual, self-efficacy, culture

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We live in a world where multicultural and multilingual mathematics classrooms are becoming more and more prevalent. People are increasingly mobile, migrating due to job opportunities or to escape war and conflict. Prior to the 1980's, there was limited research with respect to language and the teaching and learning of mathematics. However, in recent decades, there has been a growing body of research in this area (Barwell et al., 2017). The picture, however, is more complex than language considerations alone. There is also cultural diversity, both among pupils and teachers. For instance, Dafnopoulou and Palamioti (2021) point to the challenges and dilemmas experienced by bilingual teachers. These issues are not solely related to language, but also encompass cultural aspects. Moreover, their study explores how such teachers develop their professional identities while teaching in multilingual classrooms. Dafnopoulou and Palamioti's (2021) research also provides critical insight into "which factors influence a bilingual mathematics teacher's experience of teaching in multilingual classrooms." (p. 405)

While teachers develop an identity working in the classrooms, teacher education is also a crucial arena for developing an identity as a teacher (Beauchamp & Thomas, 2009). Mostly, multilingual pre-service teachers attend classes along with other Norwegian pre-service teachers. However, at the University of Agder (UiA) in Norway, we have a unique study program that is tailored to students with different first languages and a rich variety of cultural backgrounds. Students from other countries and cultures are invited to build upon their previous education from their native countries to become teachers in Norway. One of the first-year subjects taught in this bachelor program is an introductory course in mathematics teaching and learning.

Building upon previous research investigating how multilingual and bilingual pre-service teachers and practicing teachers develop their identity and experiences in this regard, we explore how a group of prospective multilingual pre-service teachers reflect upon mathematics teaching. We are interested in their experiences both in their native country and in the Norwegian classroom, and which tensions and dilemmas they might consider in their future jobs as mathematics teachers. The research question we are investigating is: "How are multilingual pre-service teachers describing mathematics teaching, and aspects related to their self-efficacy, as future mathematics teachers in Norwegian classrooms?"

We use the term *multilingual* because the majority of the pre-service teachers are fluent in several languages, and not speaking Norwegian as a first language is a requirement for the study program. By self-efficacy, we build upon the theoretical concept defined and described by Bandura (1977a): "An efficacy expectation is the conviction that one can successfully execute the behavior required to produce the outcomes." (p.193)

Conceptual considerations

Since Bandura (1977b) introduced self-efficacy as a theoretical concept, many researchers have continued to build upon Bandura's theories on self-efficacy (Usher & Pajares, 2008). Schunk (1991), for instance, defines self-efficacy as, "an individual's judgments of his or her capabilities to perform

given actions." (p. 207) Furthermore, while self-efficacy might correlate with knowledge, skills and performance, it is not necessarily dependent. As Bong and Skaalvik (2003) describe, "…efficacy judgment is less concerned with what skills and abilities individuals possess. It considers more important what individuals believe they can do with whatever skills and abilities they may possess." (p. 5)

The existing research on self-efficacy has two main perspectives: that of the student and that of the educator. Within the student perspective, students' self-efficacy and beliefs on whether they can manage to solve mathematical tasks is explored in various contexts (Zakariya, 2022). Within the second perspective, researchers are investigating teachers' self-efficacy on teaching mathematics (Xenofontos & Andrews, 2020). Our research is connected to the latter perspective, dealing with multilingual pre-service teachers.

Much of the research on self-efficacy focuses solely on quantitative measures. However, researchers have pointed out that an uncritical use of scales developed for a specific cultural/educational context may cause validity issues (Andrews & Diego-Mantecón, 2015). Also, there might be aspects related to culture and context that do not surface unless the topic is investigated using more open and qualitative methods (Xenofontos, 2018).

Theoretical framework

Xenofontos and Andrews (2020) have conducted qualitative research exploring aspects of culture and context with respect to self-efficacy, asking, "What issues, typically not captured by quantitative studies, emerge from a qualitative exploration of mathematics teacher self-efficacy?" (p. 262). As a starting point for their research, they expected responses both within teachers' mathematics self-efficacy and mathematics teaching self-efficacy. Their respondents were Greek-Cypriot teachers, and through the analysis they identified four themes related to the particularities of the context of Cyprus (Xenofontos & Andrews, 2020, p. 269). The four themes are: participants' mathematics-related past experiences, mathematical competence, realization of a didactical vision, and resilience in challenging mathematical situations (Xenofontos & Andrews, 2020, p. 269-274).

As a result, we answer the call by Xenofontos and Andrews (2020) encouraging colleagues to undertake similar qualitative investigations, given that various cultures will give more insight into the research area. Our group of multilingual pre-service teachers thus provide interesting cases to study self-efficacy variations in cultural contexts. Like Xenofontos and Andrews (2020), we use the initial conceptualization of teacher self-efficacy including two components: mathematics self-efficacy and mathematics teaching self-efficacy. However, Xenofontos and Andrews point out that their results "…indicate that, in reality, things are much more complex, as these two components often overlap and intertwine." (2020, p. 277)

Methods

In this section, we introduce the participants' backgrounds and provide a brief overview of the mathematics course. Furthermore, the means of data collection are presented and explained, followed by a description of the data analysis process. Issues related to trustworthiness and ethics are also discussed.

Participants

The participants of the study include 23 students in the pre-service teacher program for multilingual students at UiA. They come from a variety of cultural backgrounds, spanning over ten countries across four continents. However, they all have in common the fact that Norwegian is not their native language. All the students have some type of higher education from their native country, but most of them have not worked as teachers before (although some of them have worked as assistants).

Setting

The national pre-service teacher program for multilingual students leads to a formal teacher qualification for grades 1-10. In addition to the subjects' more general approach and main topics of pedagogy (comprising class management, learning management and diversity management), the course has a particular focus on strengthening the participants' awareness and attitudes towards their own cultural backgrounds. The program meets regional and national needs for competence in multilingual education and qualifies students to work as bilingual teachers and subject teachers in a multicultural society (University of Agder, 2023). The mathematics course centers around four gatherings at UiA each semester (two full day sessions, eight days for the duration of the semester). During these gatherings, students attend lectures, participate in task solving, full class discussions, student presentations and discussions, and larger projects (i.e., planning a teaching session or planning for multiple teaching sessions on a particular topic). Our work as lecturers mainly consists of supervising and managing the students' exploration and familiarizing with the Norwegian teaching culture, curriculum, local and national guidelines for teaching, and the subject matter itself. Students share their mathematical knowledge and experiences, from their own schooling, and discuss the methods and thought processes in relation to how it is usually performed and thought about in Norwegian classrooms. Furthermore, students are encouraged to familiarize themselves with standard practices in Norway, while also highlighting and adjusting their individual examples and experiences as good alternative methods to teach. In addition, the students have 20 days of practicum each year.

Each of the authors of this article has experience teaching the introductory course in mathematics teaching and learning for multilingual students. Furthermore, two of the authors hold responsibility for the group of students upon which this research article is based.

Data collection

To answer our research question, we conducted a survey consisting of three open-ended questions to 26 students participating in the pre-service teacher program for multilingual students. The open-ended questions were not initially designed with respect to self-efficacy, but this focus emerged through the analytic process (further explained under the "Data analysis" section). The survey was distributed on paper to all students during a gathering on campus (UiA), and they were given time to answer it in class. Some of the pre-service teachers wanted to reflect more, and therefore did not hand in the response until the next day. SIKT (Norwegian Agency for Shared Services in Education and Research) approved the research project as being in line with ethical guidelines, and 23 pre-service teachers provided signed informed consent before entering their responses into the research-project. They were told to use any language they felt comfortable with, answering the three survey questions:

1. How will you describe a good mathematics teacher in your native country?
2. What might worry someone from your native country about teaching mathematics in Norwegian classrooms?
3. Which advantages do you have when teaching mathematics in Norwegian classrooms?

The rationale for letting participants answer in any language they preferred was to make them feel less strained. Furthermore, they were told that their opinion was important to us, and that we would find a way to translate their response. Most participants responded in Norwegian. Some responded in Norwegian mixed with English. Three of the 23 responses had to be translated with the help of colleagues.

The variation of pronouns in the questions was deliberate. Question 1 was designed so that multilingual pre-service teachers would have the opportunity to reflect upon positive experiences of teachers in their native country, thus emphasizing positive aspects of the cultures they identify with. Question 2 was formulated so that the pre-service teachers could present challenging aspects they might worry about when it comes to teaching mathematics in Norwegian classrooms. Thus, the participants could answer from the perspective of "any" person from their home country, highlighting cultural differences, and not just the participants' personal experiences. However, in question 3, we deliberately wanted the pre-service teachers to reflect upon how their own (personal) cultural background and knowledge could be beneficial to a Norwegian mathematics classroom.

Data analysis

The data analysis was conducted in two phases. The first phase consisted of an inductive approach while the second phase consisted of a deductive analysis using self-efficacy as an analytical tool. In the inductive approach, we analyzed the pre-service teachers' answers using techniques from grounded theory (Glaser & Strauss, 1967). Each of the three authors read and searched out underlying themes in the textual data and developed individual lists of themes/codes through a step-by-step process,

adding themes as we identified them in the participants' responses. This was followed by a meeting where we discussed our initial themes/codes and impressions of the participants' answers. During an iterative inductive process, we compared our themes and identified self-efficacy as a theoretical lens that would embrace several issues the pre-service teachers raised in their answers to the questionnaire.

The second phase of the analysis process consisted of re-analyzing the data material by sorting sections of text into core categories. This was done jointly by the three researchers, discussing every quote from the survey, and agreeing upon which category of self-efficacy it belonged to. As presented in the theoretical framework section, mathematics teacher self-efficacy is often divided into *mathematics self-efficacy* and *mathematics teaching self-efficacy* (Xenofontos & Andrews, 2020). Some responses, however, pertained to other aspects of self-efficacy. Thus, our analytic tool ended up consisting of six categories: *mathematical knowledge*, *mathematical teaching competence*, *attention to pupils*, *culture*, *language*, and *personal attributes*. We used the developed category system to do one last tagging of the students' answers and collected interesting quotes pertaining to each category.

Through our research we ensured trustworthiness according to three dimensions (Guba & Lincoln, 1994) by giving a thick description of the data collection, analysis process and the choices made. We are not claiming to be neutral observants and have thus elaborated upon our roles and choices as lecturers and researchers in this project, giving the reader the possibility to evaluate possible impact. Transferability of the research is tested by international colleagues who could relate to the findings in this research.

Results

Self-efficacy is often regarded as a two-dimensional construct (Xenofontos & Andrews, 2020). The two dimensions, mathematics self-efficacy and mathematics teaching self-efficacy, relate to the two categories the research team agreed on: *mathematical knowledge* and *mathematical teaching competence*. In the following, we elaborate briefly on why we included four additional categories and present the results of our analysis.

The research team collectively established the remaining four categories, drawing upon the data obtained from the pre-service teachers participating in this research project. These categories are not particularly subject specific. The *attention to pupils* category was identified from how the pre-service teachers talked about the importance of seeing the pupils. While this might be viewed as part of mathematics teaching self-efficacy, we have chosen to highlight it as a category. This is because the pre-service teachers mostly referred to attention to pupils as a trait or a value. Regarding the categories *culture* and *language*, we debated whether this should be one or two categories, since some of the responses from the pre-service teachers can be interpreted within both categories. However, the participants are also making clear distinctions between issues of language and culture, which led us to the choice of separating the two categories. The last category we identified from the themes/codes was

personal attributes, which pertained to how the pre-service teachers described personal attributes as traits or values.

Table 1 presents an overview of the six categories, number of responses (*n*) connected to each of them, and some examples of quotes from the written responses from the pre-service teachers. We will further elaborate on the type of responses we got in each category and specify which of the three questions the answers come from.

Table 1

Issues raised on Mathematical Teaching and Self-efficacy

Category	*n*	Example Quote
Mathematical knowledge	17	"Knowledgeable in mathematics"; "Good theoretical knowledge to make abstract mathematical concepts concrete […] and understandable"; "The teachers must know the subject well enough [to be able] to pass on the knowledge to the pupils [… and] must know several ways of solving [mathematical problems]"; "I'm worried I can't explain well enough"
Mathematical teaching competence	21	"Use examples from the pupils' everyday life to bring life to the subject and make it relevant"; "Explain math in different ways to ensure understanding"; "Has several teaching methods"; "Explains and challenges so that pupils work more independently"; "[Can use] station teaching so that everyone can try and say something"; "Uses diverse methods […] and adaptation to different levels"; "Make learning interesting and fun"
Attention to pupils	16	"Asking pupils questions and making sure they understand"; "Caring for pupils, encouraging and showing respect to all children regardless of level and background"; "Facilitate weak and good pupils"; "Get into the pupils' way of thinking"; "It's all about adapting the teaching to the pupil"; "Create an environment where pupils feel mastery in different ways"
Culture	16	"Different approach to explaining [… and] uncomfortable to ask for help"; "In my home country they care more about the answer, not how they arrived at the answer"; "The way you learn mathematics in Norway is a bit different and uses different symbols"; "In Norway, there is not much theory. One is most concerned that [the pupils] understand"; "Not big differences between being a mathematics teacher in your home country and Norway"; "A lot of freedom [in Norway], and perhaps too relaxed. [In] my home country [the teacher] expects the pupils to be serious, work well and do their homework"; "The class culture in Norwegian classes can also be a challenge, I think. Where I come from, the teachers have a lot of authority"; "Pupils in Norway are very different from pupils in my home country"
Language	11	"The language can be challenging and the way of explaining can be different from the way of Norwegian teachers"; "Knowledge and understanding of numbers and concepts in several languages that can help pupils who know little Norwegian"; "Your own background can be helpful in knowing which concepts are difficult for pupils"; "The language can be the biggest challenge"
Personal attributes	9	"Mathematics is fun, and I can help pupils experience this"; "I can be more creative and adaptable"; "[Be] patient [… and] not too strict"; "Empathy, can understand children having difficulties, wanting challenges, having lost motivation"

Note. *N = 23.* The quotes are drawn from multilingual pre-service teachers' responses in the survey.

Mathematical knowledge was referred to by 17 out of the 23 respondents, and the majority of the responses pertaining to this category were identified in question 1 and 2 (see "Methods"). While the responses to question 1 were related to the pre-service teachers describing that a mathematics teacher in their native country is knowledgeable in mathematics and can answer all types of questions, the replies to question 2 revealed that a lack of mathematical knowledge was something the participants were worried about. In Norwegian classrooms, there is not only a demand for the teacher to be able to solve a task themselves, but to know various possible solution strategies. Conversely, in response to the third questions, four of the pre-service teachers made reference to their mathematical knowledge. They explained that one of their strengths lay in their ability to employ multiple methods to solve mathematical problems. However, to summarize this category, most of the participants are concerned about mathematical knowledge – emphasizing that it is not necessarily enough to be able to solve problems, and that you must have a wide repertoire of solution strategies.

The category of *Mathematical teaching competence* was assigned the most statements (n = 21) as most pre-service teachers described some aspects of teaching competence. Many of the responses in this category are similar to some of the responses in the mathematical knowledge category. The reason for this is that there is a difference to what a teacher does and what a teacher must know. While the responses in this category come from all three questions, many of the pre-service teachers emphasized the difference in focusing on product versus process in mathematical tasks. They point out that the Norwegian school system values the process of solving mathematical problems as an essential part to understanding mathematics. The responses indicate that most of the pre-service teachers are positive to this way of teaching, while some argue that a consequence is that the Norwegian school system lowers the standards and expectations to the pupils. Some participants comment on how they have broadened their horizon of what mathematics teaching can look like. For instance, they never thought it was possible to teach mathematics in the woods, which one of the pre-service teachers experienced while briefly working at a school. Another aspect identified in this category, is the demand placed on additional activities in connection to the teacher's ability to explain. While the pre-service teachers have typically expected that a good mathematics teacher excels in explanation, this singular skill is insufficient for teaching within the Norwegian school system. Teachers also need to be able to include the pupils in the discussions, ways of reasoning and solution processes. Furthermore, 14 out of the 23 participants provided answers pertaining to this category by responding to question 3 (see "Methods"), which might indicate that they have acquired some skills or knowledge that they view as valuable for future teaching.

Attention to pupils is a category assigned to responses that emphasized a dynamic relationship between the teacher and the pupils. 16 out of 23 respondents made statements in the questionnaire that were related to this category. Examples of these are: "asking pupils questions and making sure they understand", "helping both weak and good pupils", and "is interested in pupils' thinking". Most of the responses in this category came from question 1, but five of the participants also mentioned this aspect

in question 3 (where they were asked to describe advantages they would have when teaching in Norwegian classrooms).

Culture is a category that 16 of the 23 pre-service teachers addressed at some point in the questionnaire, mostly by responding to question 2 (see "Methods"). Hence, the cultural aspect is something that concerns participants when working in Norwegian classrooms. Some issues raised were related to discipline and respect for the teacher and pupils' motivation to work. The pre-service teachers experienced this to be more challenging in Norwegian classrooms than that of their native countries. Some of the respondents point to different ways of working and a different atmosphere in the classroom, while one respondent claimed that there are not that many differences. On the other hand, five pre-service teachers have also addressed cultural aspects when responding to question 3. These respondents regarded their cultural background as an asset when teaching in the Norwegian mathematics classroom.

Language was an issue raised by 11 of the participants in their responses to question 2. The main concern was teaching pupils with another native tongue, specifically when dealing with naming mathematical concepts. However, five respondents also point to how language can be an advantage when teaching in Norwegian classrooms. Firstly, they have a unique insight when dealing with bilingual or multilingual pupils. Secondly, they have knowledge pertaining to which concepts and words might be challenging for someone who does not have Norwegian as their first language.

Personal attributes, as the last category we pinpointed, encompasses statements that could not be classified elsewhere due to their focus on the teachers' personal qualities rather than their knowledge or actions as teachers. Within this category are descriptions such as "strict," "creative and adaptive," "patient," "motivating," and "empathic." Additionally, two respondents within this category expressed that they found mathematics to be "fun."

The three questions in the survey elicited different types of responses. Question 1 mostly provided information about some of the elements the pre-service teachers see as valuable for teaching mathematics. Question 2 yielded more criticism of some of the aspects from mathematics teaching in their native country and to the Norwegian school system. Question 3 seemed to be the most difficult question for them to answer, and several opted not to answer. Three participants responded that this was a difficult question to answer, and some of them responded by giving a general description of positive elements in the Norwegian school system.

Discussion

In the following section, we will connect our findings to existing research. We identified six categories (see "Results"): *mathematical knowledge*, *mathematical teaching competence*, *attention to pupils*, *culture*, *language*, and *personal attributes*. We use this structure to discuss our research question: How are multilingual pre-service teachers describing mathematics teaching, and aspects related to their self-efficacy, as future mathematics teachers in Norwegian classrooms?

Mathematical knowledge

Mathematical knowledge was important to this group of pre-service teachers as it was mentioned several times in their responses. This is related to mathematical self-efficacy, that is, the pre-service teachers' judgments of their ability to solve mathematical problems. Xenofontos and Andrews (2020) identified three themes that are related to this conceptualization of teacher self-efficacy. These themes include the impact of the participants' mathematics-related past experiences, confidence in one's mathematical competence, and their resilience in the face of challenging mathematical situations. Our pre-service teachers' responses also addressed some of these issues, but there are additional aspects that Xenofontos and Andrews's (2020) research does not reveal. While the participants in our research are concerned about their mathematical background and knowledge in mathematics, they are also nuancing what type of mathematical knowledge they need. While Xenofontos and Andrews' (2020) respondents point to mathematical competence on various school levels and whether they feel competent or not, our respondents are more concerned about knowing various solution strategies to solve problems.

These findings highlight how the initial conceptualization of teacher self-efficacy, including the two dimensions of mathematics self-efficacy and mathematics teaching self-efficacy (Xenofontos and Andrews, 2020), are not dichotomies. The pre-service teachers in our project evaluate their mathematical self-efficacy with respect to the work they will be doing in Norwegian classrooms. They are not only assessing their competence in solving mathematical problems but also their ability to employ diverse strategies and articulate their thought processes. Consequently, mathematical self-efficacy constitutes a wider scope than concerns solely about solving mathematical problems. In fact, it appears to have a strong connection with self-efficacy in mathematics teaching.

When it comes to resilience in the face of mathematically challenging situations, as described by Xenofontos and Andrews (2020), our data material does not provide any information about this aspect. However, this was an aspect we noticed through our teaching, while working with this group of pre-service teachers. We experienced that as soon as the pre-service teachers realized that the lecturer did not try to "trap them" or expose their lack of knowledge, but supported them in their endeavors, their knowledge and resilience when solving problems increased.

Mathematical teaching competence

Various aspects of mathematical teaching competence were brought up by our pre-service teachers. These relate to mathematical teaching self-efficacy, that is, their judgments of their ability to teach mathematics in Norwegian classrooms. Xenofontos and Andrews (2020) identified a theme they named *perspectives on the realization of a didactical vision*. In their research, the teachers described various elements of teaching that they felt competent in. This could for example be creating challenging learning environments, creating safe learning environments or being particularly open-minded in comparison to other colleagues (Xenofontos & Andrews, 2020, p. 280). On the other hand, the responses

from our pre-service teachers indicate that they are still developing their perspectives on didactical visions, more so than they are reflecting on their abilities to realize them. Through their answers, we identified that the pre-service teachers are both reflecting on positive experiences in mathematics classrooms from the country they grew up in, as well as broadening their horizon on teaching possibilities they learned about in the Norwegian classrooms. These pre-service teachers have realized that teaching mathematics can be done in various ways, and that it is possible to include the "best" from several cultures when forming their own didactical vision. Our results show that they are currently in the process of defining and understanding the concept of teaching competence and identifying the areas they need to focus on in order to enhance their mathematical teaching self-efficacy. Consequently, we found it necessary to introduce an additional four categories to specify certain crucial aspects that these pre-service teachers take into account regarding their mathematical teaching self-efficacy.

Attention to pupils

While attention to pupils is an aspect related to mathematical teaching competence, we have chosen to present it as a category of its own. Attention to pupils can also be found in the work of Xenofontos and Andrews (2020), but they have included it in the teachers' *perspectives on the realization of a didactical vision*. Nonetheless, our pre-service teachers emphasized the importance of attending to the needs of pupils as a commendable quality of effective mathematics teachers from their native country. They also underlined this as a positive attribute in themselves when preparing to teach in Norwegian classrooms. Furthermore, their self-efficacy in addressing pupils' needs was high, as they recognized the advantages of being proficient in multiple languages and understanding diverse cultural backgrounds when engaging with their pupils. This could potentially explain why our pre-service teachers frequently emphasized the significance of pupils in many of their responses.

Culture and language

Both culture and language are aspects of self-efficacy that can be related to both mathematics self-efficacy and mathematics teaching self-efficacy. These aspects, not part of Xenofontos and Andrews' (2020) work, make up an important part of our data material and appear to be a consequence of who our respondents are. We argue that culture and language are aspects of mathematical self-efficacy because our pre-service teachers show concerns about different strategies and algorithms for solving problems in various cultures in combination with the challenges of fully understanding and communicating mathematical concepts. Correspondingly, culture and language are also aspects of mathematics teaching self-efficacy. Our pre-service teachers are unfamiliar with the teamwork- and dialogue-oriented hierarchical structure typically found in Norwegian classrooms, where teachers often must earn authority and trust from their pupils. In other words, the mode of communication between teachers and pupils in Norway is different from the mode of communication the pre-service teachers have previously experienced, where the teacher is viewed as the authority by virtue of position and is

seldom questioned. Hence, these pre-service teachers must acquire the skills to adapt, both in terms of culture and language. This makes their teacher education more challenging compared to other Norwegian students who do not face this level of complexity.

Personal attributes

The responses related to personal attributes were categorized separately, since they did not neatly align with the other established categories. Nonetheless, the responses from the pre-service teachers within this category shed light on certain traits they consider significant in their didactical vision. We therefore infer that these are qualities they will aim to embody as they commence their careers as teachers.

Conclusion

Our research shows that self-efficacy among multilingual pre-service teachers is a complex matter. While prior research has mainly focused on mathematical self-efficacy and mathematical teaching self-efficacy, our findings underscore the necessity for delving deeper into these theoretical concepts and examining them with greater detail. This holds particularly true for individuals with multilingual abilities and diverse cultural backgrounds, highlighting the demand for further research in this domain.

On the other hand, our results also suggest that the multilingual backgrounds of these pre-service teachers can serve as an advantage when they transition into roles as mathematics educators. They possess a broader understanding of potential approaches to mathematics teaching, a range of algorithms, and diverse viewpoints on classroom dynamics. Consequently, these pre-service teachers could offer significant value to Norwegian classrooms, provided that we recognize and appreciate their knowledge and perspectives.

There is a need for additional research investigating not only the challenges multilingual pre-service teachers may encounter but also the advantages and benefits they offer. Our findings build upon the research of Xenofontos and Andrews (2020), who similarly highlight the importance of investigating cultural factors and language-related issues concerning self-efficacy. In previous research, the instruments used to analyze aspects or dimensions of self-efficacy rarely took culture and context into account. Our research, however, underscores the necessity of incorporating these aspects into the analysis. We contend that programs especially tailored for these group of students, such as the one offered at the University of Agder, can prove highly beneficial. The teacher training program tailored for multilingual teachers serves as an environment where students can learn to both appreciate their cultural backgrounds and recognize the teaching opportunities within the Norwegian school system in which they will be employed.

References

Andrews, P., & Diego-Mantecón, J. (2015). Instrument adaptation in cross-cultural studies of students' mathematics-related beliefs: Learning from healthcare research. *Compare: A Journal of Comparative and International Education, 45*(4), 545-567. https://doi.org/10.1080/03057925.2014.884346

Bandura, A. (1977a). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191-215. https://doi.org/10.1037/0033-295X.84.2.191

Bandura, A. (1977b). *Social learning theory*. Prentice Hall.

Barwell, R., Moschkovich, J. N., & Phakeng, M. S. (2017). Language Diversity and Mathematics: Second Language, Bilingual, and Multilingual Learners. In J. Cai (Ed.), *Compendium for research in mathematics education* (pp. 583-606). National Council of Teachers of Mathematics.

Beauchamp, C., & Thomas, L. (2009). Understanding teacher identity: An overview of issues in the literature and implications for teacher education. *Cambridge Journal of Education*, 39(2), 175-189. https://doi.org/10.1080/03057640902902252

Bong, M., & Skaalvik, E. M. (2003). Academic self-concept and self-efficacy: How different are they really?. *Educational psychology review*, *15*, 1-40. https://doi.org/10.1023/A:1021302408382

Dafnopoulou, D., & Palamioti, N. (2021). The experience of teaching mathematics in a multilingual classroom: The case of a bilingual teacher. *Exploring New Ways to Connect: Proceedings of the Eleventh International Mathematics Education and Society Conference, 2*, 404–413. https://doi.org/https://doi.org/10.5281/zenodo.5413629

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Aldine de Gruyter.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105-117). Sage.

Schunk, D. H. (1991). Self-Efficacy and Academic Motivation. *Educational Psychologist, 26*(3-4), 207-231. https://doi.org/10.1080/00461520.1991.9653133

University of Agder. (2023, October 5). *Teacher education for bilingual teachers*. UiA. https://www.uia.no/studier/laererutdanning-for-tospraaklige-laerere

Usher, E. L., & Pajares, F. (2008). Sources of Self-Efficacy in School: Critical Review of the Literature and Future Directions. *Review of Educational Research*, 78(4), 751-796. http://www.jstor.org/stable/40071145

Xenofontos, C. (2018). Greek-Cypriot elementary teachers' epistemological beliefs about mathematics. *Teaching and Teacher Education, 70*, 47-57. https://doi.org/10.1016/j.tate.2017.11.007

Xenofontos, C., & Andrews, P. (2020). The discursive construction of mathematics teacher self-efficacy. *Educational Studies in Mathematics, 105*(2), 261-283. https://doi.org/10.1007/s10649-020-09990-z

Zakariya, Y. F. (2022). Improving students' mathematics self-efficacy: A systematic review of intervention studies. *Frontiers in Psychology, 13*, 1-13. https://doi.org/10.3389/fpsyg.2022.986622

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