CHAPTER 6

Exploring STEM Teacher Educators' Gender Awareness and Understanding of Gender-responsive Pedagogies in Kazakhstan

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Introduction

Central Asian women demonstrate relatively high enrollment rates in higher education. For instance, women's enrollment in higher education is 55% and 57.6% in Kazakhstan and Kyrgyzstan, respectively (UNESCO, 2021). Although at 45.6% enrollment in Uzbekistan and around 38% in Tajikistan, women are underrepresented in higher education, both countries report improvement in women's participation rates. For example, Uzbekistan reported a fivefold increase in women's enrollment in higher education (President of Uzbekistan, March 2023). In Tajikistan, there was a 10% increase in women's enrollment in higher education compared to 2017 (Tajstat, 2017). However, in light of overall favorable women's

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educational positions, it is remarkable that Central Asian women are underrepresented in STEM fields in higher education. In 2018, for instance, no more than 30% of young people enrolled in STEM programs in Kyrgyzstan were women (UNESCO, 2021). The gender gap in STEM fields is even more prominent in Tajikistan (Kataeva, 2022). Overall, Central Asian countries demonstrate significant gender gaps in STEM fields.

The underrepresentation of women in STEM disciplines can be viewed as a cumulative problem. A smaller number of girls are engaged in STEM-related activities at the secondary school level. This trend persists after school graduation when future majors are selected (Almukhambetova & Kuzhabekova, 2020). According to UNESCO (2021), these gender differences become even more prominent when it comes to transition to the job market and career advancement.

The decreasing participation of women in STEM is highly undesirable from various standpoints. Research suggests that sustainable development and economic prosperity are more likely in economies with higher levels of gender equality. In this regard, gender has a political-economic dimension as it structures the division within paid labor between higher-paid male-dominated occupations and lower-paid female-dominated occupations (Fraser, 2020). This also reinforces the gendered norms around inferior roles of women not only within households but also in society, as low wages and limited employment opportunities deflate the social status of women. This results in a political-economic structure that generates gender-specific modes of marginalization (Fraser, 2020).

Promoting gender equity in STEM challenges the preconception that women are less competent in scientific fields than men and helps to eliminate discrimination in education and employment. Expansion of opportunities for women in high-paying STEM occupations will lead to women's empowerment. More education and career opportunities, especially in high-paying fields, give women a voice against social and political injustice, help reduce social inequality, decrease social tension, and eventually lead to social and economic development in the region.

Kazakhstan, one of the Central Asian countries, presents a critical case for analyzing women's underrepresentation in STEM. Kazakhstan scores higher than other Central Asian countries on gender indicators (UNESCO, 2021). Women's enrollment in higher education in Kazakhstan is progressively higher than that of men (UNESCO, 2021), giving the initially promising picture of gender equity in Kazakhstani education.

However, there is a significant overrepresentation of male students in the bulk of STEM majors, with significant variation across the subjects. As a result, high-paying STEM sectors are heavily male-dominated, while in low-paying health care and education, there is a significant overrepresentation of women. There is also a significant wage gap, with women earning only 68.6% of men's wages.

The voices of STEM women in Kazakhstan suggest that they confront hidden barriers, mostly rooted in social and cultural expectations from women (Almukhambetova et al., 2022), and the critical stage when they need to receive gender-responsive academic and career counseling is at high school when academic pathways are selected (Almukhambetova & Kuzhabekova, 2020). Although previous research highlights teacher educators' gender awareness as one of the priority factors, STEM teachers often display little understanding of their agency to challenge the underrepresentation of women in STEM (Durrani, 2022).

Pre-service teacher education is the most effective way to ensure that future teachers are able to reflect on their gendered practices and use education as a means to promote gender equality. Therefore, it is important to explore teacher educators' gender awareness and understanding of gender responsiveness in pedagogy, as they are the actors who shape pre-service teachers' knowledge, skills, and professional identity. This will help identify the underlying tensions in STEM teacher education that hinder the progress toward implementing gender-responsive instruction and career counseling. Equipped with a better understanding of the teacher-related hindrances that women face in their education as well as the factors that influence their performance and retention in STEM, policymakers can implement measures to improve women's recruitment and retention in STEM fields.

Literature Review and Theoretical Framework

Several studies have been conducted in Kazakhstan to understand why women are underrepresented in STEM occupations. Prior research suggests that parents and extended family members often discourage girls from choosing STEM university majors (Almukhambetova & Kuzhabekova, 2020). While pursuing STEM higher education, young women confront hidden biases from male professors and male peers, mostly rooted in women's social and gender expectations (Almukhambetova et al., 2022). Even if the girls find themselves in a supporting

university environment, they continue to face low expectations regarding their future employment in STEM from family members and potential employers (Almukhambetova & Kuzhabekova, 2021).

Previous research suggests that the educational process can improve or constrain girls' engagement in STEM. School textbooks often frame STEM as a male-dominated domain (Durrani et al., 2022). School teachers often hold gender stereotypes and are not always aware of their agency to challenge the underrepresentation of women in STEM. Such factors as teachers' gender awareness and gender responsiveness, professional development and support (Kalu, 2005; Chikunda, 2014) are critical in improving not only access, performance, and engagement with STEM studies but also further career choice.

Therefore, in order to step forward toward gender equity in STEM, there is a need to improve teacher training in particular. The evidence suggests that teacher education often fails to equip future teachers with the values, attitudes, and skills required for gender-responsive instruction and advising (Khalil et al., 2023). Limited teacher education policies are not aimed at addressing the inequities in education. As a result, teachers are often unaware of gender-responsive teaching strategies or graduate from teacher training universities without knowing how to address gender issues in their practices (Kalu, 2005).

Meanwhile, the research around gender and STEM education reports on various factors that affect girls' decision to pursue careers in STEM, which teacher's intervention can mitigate. Despite their strong aptitudes in sciences and math, girls often have a lower level of confidence and interest in STEM subjects than boys (Stoet & Geary, 2018) and their self-concept tends to decline as they progress through their studies (Murphy & Whitelegg, 2006). As a result of the low confidence and interest level, girls are less likely to enroll in STEM subjects at the high school level, especially in subjects later required to enroll in college-level engineering, physics, and computer science courses.

Implicit gender bias is often manifested in STEM curricula and assessments (Miske, 2013). Girls are often sidelined by their male peers STEM classrooms and laboratory activities, who take leadership roles in using the classroom material and equipment. Such classroom practices impede female students' self-esteem and attitudes toward science. Therefore, teachers' advising and gender-responsive instruction are critical in determining the female students' feelings toward STEM subjects and their self-concept in relation to it (Murphy & Whitelegg, 2006).

The gender-responsive pedagogies can create a supportive environment for girls to accommodate their needs, enhance their interests, and benefit from participation in all classroom and laboratory activities.

Research also shows that male and female students do not share the same educational goals. Female students might be more idealistically oriented than male students as they aspire to contribute to society and help people (Sinnes & Løken, 2014). As female students often believe that STEM subjects lack relevance for their goals, gender-aware teachers can engage with students' beliefs about STEM, increase their motivation to study STEM subjects, and influence their alienation from it (Krogh & Thomsen, 2005; Murphy & Whitelegg, 2006). Such issues as insufficient peer support in class (Graham et al., 2013), subtle forms of discrimination in group work, combined with the overpowering image of the STEM profession as a masculine occupation, contribute to the feeling of poor fit and self-doubt, and discourage the girls from full engagement with STEM subjects. Differential teaching and assessment strategies and compensatory interventions can eliminate these issues. In addition, certain interventions to STEM curricula can also help to address the girls' missing skills due to the lack of engagement with STEM outside classes (Murphy & Whitelegg, 2006) and eliminate the gender gaps in students' performance and teachers are the key to the success of these interventions.

While the literature points out the importance of gender responsiveness in curriculum and instruction and the teachers' gender awareness, there is a lack of research on how teacher educators understand and implement gender responsiveness in educating future STEM teachers. Therefore, this chapter targets STEM teacher educators in several teacher training universities in Kazakhstan to explore their gender awareness and understanding of gender responsiveness in educating future STEM teachers.

The study will be framed by the 4Rs framework (based on Fraser's social justice theory), which uses the concepts of recognition, redistribution, representation, and reconciliation with respect to socio-economic and cultural processes that marginalize women from educational and employment opportunities. According to Fraser (2007), any struggle for gender justice implies redistribution (achieving egalitarian socio-economic structures), recognition and representation (recognizing diversity and enabling equal participation), and reconciliation (addressing the barriers for marginalized groups) (Novelli et al., 2019). The application of this framework will offer a novel PEA perspective on how to address the teacher-related hindrances in women's participation in STEM education in a Central Asian context.

Methodology

The study employed a qualitative research approach (Creswell & Poth, 2016). Semi-structured interviews were the main method of data collection since they provided an opportunity for the researcher to understand the participants' experiences in the words of the participants themselves, allowing to combine the organization of the dialogue around themes suggested by the literature and flexibility to follow up on unexpected themes dynamically. The process of conducting the study was guided by ethical principles and regulations of the University of Ulster. The data collection started after obtaining the ethics committee's approval. Twenty-two STEM teacher educators working in five teacher training universities in Kazakhstan were interviewed (see Table 6.1 for more details on the participants' background characteristics).

Table 6.1 Participants background characteristics

Region	*Gender*	*STEM domain*	*Teaching experience*	*Age*	*Code*
North	F	Chemistry	19+	–	A
North	F	Biology	10+	–	B
South	M	Maths	15+	40	C
South	F	Physics	15+	38	D
South	F	Maths	15+	40	E
North-East	F	Maths	20+	48	F
Almaty	F	Chemistry	25+	53	G
North	M	Chemistry	6	28	H
North-East	M	Physics	18	40	I
North-East	F	Informatics	17	42	J
North-East	F	Informatics	10	37	K
South	F	Computer Science	5	30	L
South	F	Computer Science	10	34	M
Almaty	F	Chemistry	15	40	N
North-East	F	Informatics	12	–	O
North	F	Physics	12	35	P
North-East	M	Informatics	10	32	Q
North	F	Physics	10+	36	R
South	M	Computer Science	7	35	S
South	M	Computer Science	5	33	T
Almaty	F	Chemistry	15	40	U
North	F	Biology	10+	–	V

The interview protocol consisted of 15 questions, which were developed based on previous research on gender responsiveness in teaching, as well as the literature on school-related barriers to women's underrepresentation in STEM. The participants who agreed to take part in the study were contacted by the author to schedule an online or face-to-face interview. Due to time constraints, 14 interviews were conducted online via Zoom by research assistants or the author.

Each interview started with an explanation of the purpose of the research and anonymity and confidentiality measures to protect the participants' identities. The participants were then offered to sign an informed consent form. The interviews lasted for about 40–60 minutes, were recorded by the interviewer, and then transcribed. Sixteen interviews were conducted in the Russian language, and six interviews were conducted in Kazakh language. All interviews were entered into NVivo 12 software to organize and analyze the data.

The following research questions guided the study:

RQ1: To what extent are STEM teacher educators gender-aware and demonstrate their agential potential to engage with gender issues in STEM?

RQ2: How do teacher educators understand gender-responsive pedagogies?

RQ2.1: What do the teacher educators do to teach gender-responsive instructional strategies and curriculum practices to future STEM teachers?

RQ 2.2: What are the underlying tensions in STEM teacher education that hinder the progress toward gender-responsive instruction and curriculum practices?

Findings

Teacher Educators' Perceptions of Barriers to Girls and Women's Participation in STEM

When asked about the problem of the underrepresentation of girls and women in STEM, teacher educators agreed on the presence of certain stereotypes associated with "feminine" and "non-feminine" jobs. For example, a female participant commented: "I think the main reason why

there are fewer girls is the stereotype of feminine and non-feminine jobs" (Participant-P, female, Physics).

Another societal gender stereotype reported by the participants is that women are incapable of performing well as a professional while being married and having children. As a female teacher stated, if the woman is married, she is at once constrained by domestic chores, and people do not expect her to be able to cope with both-family responsibilities and be a highly qualified professional (Participant-P, female, Physics). With regard to STEM, for a woman, starting a marriage almost always means that she ends her career. The quotes below are particularly illustrative:

> Let's say, there is a girl, she gets married and all, but the computer sphere is developing every day, so … You understand? The girl wouldn't manage that physically, she's taking care of a baby for a year (maternity leave), and then she wouldn't be able to keep up. (Participant-E, female, Mathematics)
>
> There are usually different comments, like: Why do you need mathematics, you are going to marry tomorrow and that's all. (Participant-F, female, Mathematics)

According to the participants, one of the reasons stems from how girls and boys are socialized in their families. Men are socialized to prioritize careers, while women are expected to prioritize marriage and having children. As one participant commented: "Boys are brought up differently as they need to be stronger…they receive more attention as they are treated differently, and girls are brought up as calm and reserved as they are female gender" (Participant-A, female, Chemistry). Another participant also noted that the main reason is the difference in upbringing:

> I came to the conclusion that the traditional upbringing that we give girls is to be calm and obedient. And for the boys, it is the opposite, o be active and strong, and the boys know how to cope with competition and stress. So, the main reason is the different upbringing that we give to boys and girls. (Participant-B, female, Biology)

TEM teacher educators almost unanimously stated that another barrier to women's participation in STEM is the influence of parents on girls' decisions of whether to pursue a career in STEM fields or not. Most participants agreed that parents in Kazakhstani households have a significant influence on girls' decisions. They also highlighted that it is a part of Kazakhstani culture to teach the girls to be subordinate to other peoples'

decisions and think in advance if their future jobs are going to constrain them from their "main role of being a good wife." As one participant commented: "Traditional beliefs of the parents, they do matter. We still give traditional upbringing to our girls, to be calm and subordinate, and it's a pity that exactly because the girls choose other fields" (Participant-F, female, Mathematics). Another participant added: "Girls are often told by parents that easy majors are better for them, Philology, for example. Parents mostly influence that choice" (Participant-R, female, Physics).

Importantly, when asked about the main barriers to girls' and women's representation in STEM, none of the teacher educators mentioned any school or teaching-related barriers to girls' and women's participation in STEM. They mostly blamed parents for the gendered upbringing, the government for the absence of gender-related policies, and the media for the lack of popularization of science. As one teacher stated, the only measure to address the issue of having few women in STEM is to provide more grants and even quotas to encourage girls to enroll in STEM majors: "The government needs to provide grants, even quotas for technical specialties" (Participant-T, male, Computer Science).

In addition to being unaware of the role of education in addressing the underrepresentation of women and girls in STEM, teacher educators unanimously stated that there is no gender-based discrimination in Kazakhstan. As one interviewed teacher educator stated: "In our country, we don't have gender discrimination, you know that" (Participant-Q, male, Informatics). Similarly, a female participant commented: "I notice that there are no gender differences in school and university – we don't have that in Kazakhstan" (Participant-D, female, Physics). This signals STEM teachers' gender "blindness," which can be detrimental to promoting gender equality in and through education.

Overall, the data analysis revealed that STEM teacher educators demonstrate only a surface understanding of barriers that girls and women encounter in STEM and a limited understanding of teaching-related influences on girls' and women's participation in STEM.

STEM Teachers' Understanding of Their Agency and Gender-Responsive Pedagogies

As the key agents of addressing the issue of women's underrepresentation in STEM, teacher educators require appropriate knowledge of gender-related issues in STEM education. As it became clear from the

interviews, STEM teacher educators demonstrate a limited understanding of their agency in addressing gender inequality in STEM. Only two out of 22 teacher educators mentioned the important role of teachers in developing students' interest in STEM. As one of them commented: "I think that we have very few trained teachers who are able to instill the interest in science, technology, and programming, and attract the students to science projects and research" (Participant-J, female, Informatics). Another comment: "The student should be genuinely interested in attending the lesson, and only because of this interest will the student choose this profession in the future. The role of the teacher is critical here. We still cannot teach the girls: make them understand that they are as cool in science as the boys" (Participant-H, male, Chemistry).

The analysis identified that teacher educators were not aware of what gender-responsive pedagogy entails. The participants also agreed that they have never been trained to teach gender responsiveness and have never discussed gender-responsive instruction with their colleagues. They seem to lack pedagogical knowledge and skills to incorporate gender-responsive pedagogy in their training of pre-service STEM teachers.

The study findings also show that almost all participants were unfamiliar with differentiated teaching and assessment strategies pertaining to students' gender. As one of the participants stated: "I do not practice this [gender responsiveness]. I give the same instructions to all; I do not have a personal approach according to students' gender" (Participant-G, female, Chemistry). Others also commented:

> When you go to class, you never think that there might be any gender differences. (Participant-M, female, Computer Science)
>
> For the teacher-they must be equal both male and female students. When we assess the students, we do it based on certain criteria, and we do not have any gender-sensitive assessment strategies which differ depending on the fact if you are a girl or a boy. (Participant-R, female, Physics)

Even if teacher educators thought that sometimes female students needed more support, they still attributed this to their deficiencies. As one participant commented: "I think that female students need more mentorship as they are less concentrated compared to male students" (Participant-K, female, Informatics).

The participants also stated that they never train pre-service teachers how to engage both male and female students more efficiently in STEM-related activities, how to promote equal opportunities in their learning, and how to avoid unintentional gender stereotyping in the classroom. Moreover, not all the participants understand that students' learning styles might differ with regard to students' gender. There was also little understanding of gender responsiveness in curriculum design and gender differences in students' motivation levels. Only one participant stated that this lack of understanding needs to be reconsidered: "we need to take this more seriously–what we lack in education. Unfortunately, it is too far from reality… but if there was a reform in curriculum design- this could be definitely changed…" (Participant-F, female, Mathematics).

STEM Teachers' Gendered Views and Sexist Attitudes

The study identified that STEM teacher educators not only display a lack of knowledge of gender issues in STEM education and gender responsiveness in teaching but also actively reproduce gender through their gendered views on students' abilities, gendered practices, and discriminatory attitudes.

STEM Teachers Educators' Views on Students' Abilities

The analysis of interview data revealed teacher educators' gendered perceptions of girls' and women's abilities in STEM. Several participants stated that women are not biologically inclined to succeed in STEM, while men are naturally smarter than women:

> Men are the ones who engage more, also because it's the technology and electronics- all more of a male thing. I accept it. Technology and electronics are theirs!...males are intellectually better; they're interested in electronics. (Participant-E, female, Mathematics)

Others argued that the STEM field is associated with male traits such as being "persistent" and "psychologically stable," whereas women are "irrational," "too emotional," "less focused," and "multifunctional,' the latter characteristic bearing a strong negative connotation. As one participant comments: "If we look at the IT sphere, mainly males choose this field…as they are more psychologically stable" (Participant-H, male, Chemistry). Other likewise commented:

> They [men] go for IT more because they're more interested, and they will persist once they're interested in making robots etc.; it's their male character; they always persist. (Participant-E, female, Mathematics)
>
> A man into chemistry – they're only into chemistry – it's their character, they don't look back, they go till the end. But girls are … They take up English, history, and this, and that … Multifunctional. (Participant-E, female, Mathematics)

These types of gendered assumptions might construct different expectations from female and male students and teach pre-service teachers stereotypical ways of doing gender. Viewing gender differences as natural entails perceiving boys' and girls' abilities as static and unchangeable. Viewing male and female students differently, with differences rooted in biology rather than similar, signals teacher educators' unawareness of gender inequalities and societal stereotypes from which these inequalities stem. This might create a gendered learning environment that treats female and male students differently.

STEM Teacher Educators' Views on Gender Role Stereotypes

As mentioned previously, the gendered views on girls' and women's abilities in STEM could have stemmed from social stereotypes and gender role stereotypes existing in society. Most teacher educators seem to conform to gender role stereotypes that are prescribed to girls and women. As one participant stated: "Our [women's] role is different" (Participant N, female, Chemistry). "In our KZ culture, too, we have to cook food and care for kids; we can't say we are going to do something [meaningful]" (Participant-E, female, Mathematics).

Some participants were even very defensive of their views, arguing that it is normal to have fewer women in STEM areas. They did not even support the idea that men and women should be equally represented in STEM. As one teacher stated: "Do we need to change the situation at all? Maybe leave it as it is [women are underrepresented], as this is normal? Why do we need to address this problem and attract more women to STEM? There is no need" (Participant-I, male, Physics). A similar quote from another participant: "We want more girls in STEM area? For what?" (Participant-Q, male, Informatics).

The comments above point out that teachers are socialized in a gendered patriarchal society that fosters gender inequality (Peshkova &

Thibault, 2022; Thibault & Caron, 2022). Teacher educators' patriarchal socialization in the context of strictly defined gender norms is a contributing factor to their lack of gender awareness and unwillingness to implement gender responsiveness in their teaching practices.

Teacher Educators' Sexist Attitudes and Gendered Practices

The study identified an association between the teacher educators' gendered views on students' ability and their gendered teaching practices. The comment from a participant who describes active teacher-student engagement with those students who, in her view, are more capable in STEM is particularly illustrative:

> I see those students who are more capable and then work with these students more … I do not practice gender responsiveness. Male or female students, I do not care, I just engage more with those students who are more capable, but, as you understand, they are mostly males. (Participant-I, male, Physics)

Another example of gendered practices that teacher educators seem to communicate to pre-service teachers included: "The boys should be stronger; that's why the teacher should explain to them that they are '*jigits*' [horse riders]. And the teachers need to explain to girls that they are a weaker gender" (Participant-G, female, Chemistry).

Overall, about half of the teacher educators displayed discriminatory or even sexist attitudes to girls' and women's academic achievement, women's representation in STEM, and their choice of subjects.

Conclusion

The purpose of this study was to generate insights into the tensions associated with STEM teacher educators' gender awareness and their understanding of gender-responsive pedagogies in Kazakhstan. It has become evident that teacher educators have little understanding of how the gender gap in STEM fields is associated with teaching and attributed it to other factors, such as family/ parents influence, stereotypes about STEM professions, lack of government policies, and influence of media.

The findings also reveal that STEM teacher educators display a limited understanding of gender-responsive pedagogies and differentiated instructional and assessment strategies. STEM teacher educators also

demonstrate low levels of gender awareness and a lack of knowledge and skills for implementing gender-responsive pedagogies. Moreover, teacher educators also seem to hold strong beliefs in men's superior performance in STEM (Copur-Genturk et al., 2020). These gendered attitudes predict women's self-perceptions of their abilities in STEM and future success in STEM above and beyond academic performance as they limit the aspirations of female students who assimilate these attitudes (Sansone, 2017). The students are more likely to be disengaged in STEM subjects if teachers project gender stereotypes. Moreover, if STEM teacher educators hold gendered attitudes and values, it means that they transmit these values to pre-service teachers (Chicunda, 2014).

With respect to teachers' agency for addressing gender inequities, shifting STEM teachers' gendered views also presents a challenge. STEM teacher educators in Kazakhstan display a lack of agency to embody and enact gender justice. Their enactment of teaching is highly influenced by gender role stereotypes existing in Kazakhstani society, as STEM teachers endorse these stereotypes. This reflects in their gendered practices and discriminatory attitudes. Through their gendered practices, teachers also communicate their views, values, and beliefs about the subject they teach (Grootenboer & Ballantine, 2010). It has also become evident that STEM teacher educators are not in the position to systematically engage with the problem of girls' and women's underrepresentation in STEM, thereby limiting the agency of pre-service STEM teachers to engage with this issue when they start to teach at schools.

Revealing these STEM teacher educators' gendered views and practices, it is important to suggest ways to challenge them. In the following section, the mitigating strategies to address the tensions associated with STEM teacher education and perceptions of inequity in STEM are discussed.

Applying the 4R Framework for Addressing the Tensions in STEM Teacher Education

Recognition

As Fraser (2001, 2007) argued, when cultural structures restrict women and deny them the resources (in our case, access to quality STEM education and STEM careers) to be on equal grounds with men, the under-recognition and maldistribution become issues of gender justice.

In the context of STEM teacher education, recognition involves acknowledging and addressing the ways in which STEM teacher educators may hold gendered attitudes and beliefs that can impact their understanding and implementation of gender-responsive pedagogies. This can include recognizing the existence of gender stereotypes that contribute to these attitudes and practices, as well as recognizing the lack of consistent policies, addressing gender inequality as well as understanding any cultural, historical, and socio-economic factors that may influence these gendered attitudes and beliefs.

Redistribution

Redistribution refers to the ways in which resources and opportunities are distributed among different groups of people. In the context of STEM teacher education, redistribution involves addressing how gendered practices in STEM teaching may be limiting the opportunities for female STEM students.

Certain measures should be implemented to eliminate the gendered practices in STEM teaching. The tasks in STEM subjects should be gender-sensitive in a way that meets the specifics of students' learning styles. The content of STEM teaching materials and textbooks should avoid stereotypical language and images. The materials should also contain images or representations where the traditional division of labor is reversed, and both women and men are promoted as being equally successful in STEM occupations. The curriculum should reflect the positive representation of women working in STEM fields. The students' existing knowledge should be considered as, in many cases, girls might not have the same exposure to STEM activities and might not possess some skills at the same level as boys (e.g., ICT skills). Therefore, teachers should select the STEM activities as well as the course material and assessment based on an understanding of students' existing skills and preparedness. Teachers should promote a discussion with school administration and parents if, in some subjects and STEM clubs/activities, the girls are particularly underrepresented.

Representation

Representation refers to the ways in which different groups of people are represented in various spheres of society. In the context of STEM teacher education, representation involves addressing the lack of training, mentoring, and professional development opportunities both for STEM

teacher educators and STEM teachers. As critical actors, STEM teacher educators need to be exposed to training and professional development on how to incorporate gender responsiveness and gender-responsive instructional and assessment strategies in teaching pre-service STEM teachers. This training should be incorporated into teacher training programs across Kazakhstan. The study highlights the need for supporting teacher educators' professional development to help improve their knowledge of gender responsive pedagogy in addition to improving their gender awareness and eliminating gendered attitudes and practices.

Reconciliation

In the context of STEM teacher education, reconciliation means implementing policies and practices that raise awareness of teaching-related hindrances and empower STEM teachers to enact their agency and work toward creating a more inclusive and equitable STEM education system. STEM teachers at all levels should display a conscious effort to promote girls' interests in STEM. There needs to be a shift in STEM teacher educators' awareness toward becoming more agentic and engaging more talented female students to STEM, making it more inclusive and welcoming for girls.

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