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The Role of Simulation in Exposing Hidden Gender Biases: A Study of Motivational Discourse in Mathematics Education †

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Abstract: This study investigated the value of simulation workshops designed to enhance motivational discourse between mathematics teachers and struggling students who have difficulty keeping up with the curriculum, especially in advanced mathematics. Grounded in the self-determination theory, we examined teachers' motivational discourse by having them participate in simulated individual dialogues with students, with a focus on the differences in the motivational discourse with male and female students. Twenty-nine middle school mathematics teachers (89.6% female; mean experience = 9.4 years, SD = 8.7) participated in the online simulations, each of which presented a scenario where an actor portrayed a struggling student contemplating dropping out of math class. Based on the observational measures of motivational discourse, the findings reveal significant gender disparities in that teachers tended to provide more support and autonomy to male students. Moreover, they tend to direct more frequent and intense autonomy-suppressing behaviors toward female students. The results highlight the efficacy of simulation-based workshops in uncovering teachers' hidden behavioral patterns. It also highlights the importance of simulation-based learning to tailor professional development issues and for addressing unconscious gender biases in mathematics education.

Keywords: self-determination theory; simulation-based learning; motivational dialogue; teacher training; gender biases

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1. Introduction

1.1. Simulative Experience in Education

Simulation-based learning in education is designed to enhance the development of the teaching skills and competencies required by educational teams in their work. In recent years, there has been a growing use of simulation in teacher training programs specifically designed to aid coping with situations of conflict and for developing teachers' social-emotional competencies and conflict resolution skills [1–3]. The main purpose of simulations as a tool in training processes is to bridge the gap between theory and practice in safe learning conditions. An additional advantage of simulations is that they allow experience with events that participants have no other opportunity to practice, for example, due to ethical reasons. Clinical simulation involves handling an educational event with a professional actor. After the experience, a reflective learning process takes place, centered on a video-based debriefing. This is based on the principles of experiential learning [4] and fosters the formation of new knowledge as a result of the integration of concrete experience to help conceptualize theoretical ideas. Many simulation workshops deal with the development of teaching skills suitable for all disciplines in education, yet the use of simulation workshops in specific disciplinary fields is also developing to promote skills unique to the discipline and the context of studies like music [5], physical education [6] and the arts [7]. However, these are still in their early stages, and there is little research on them.

The current study deals with simulation workshops that were created specifically for mathematics teachers. It was conducted in Israel, where there has been a national effort to increase high-level mathematics enrollment in the Israeli educational context, particularly in light of ongoing reforms aiming to close gender gaps in STEM fields. The study focuses on the development of motivational discourse with students while addressing the differences in teachers' motivational discourse between boys and girls. While previous studies [8] have primarily focused on teaching skills and social-emotional competencies in the classroom, the present study highlights the importance of individual conversations with students and potential teacher biases in one-on-one motivational interactions with students who are experiencing learning difficulties and failure. Investigating the simulated teacher–student discourse not only strengthens the connection between research and practice within the simulation itself, but also promotes a training process that bridges motivational theory and experimentation to actualize improved teaching practices.

1.2. Retaining Students Sutdying Higher-Level Mathematics

Mathematics is considered a particularly important subject as it is perceived as a necessary skill that guarantees professional and economic success both in everyday life and for work. The subject's importance is also reflected in schools, since many students and schools are measured by their success in mathematics more than any other subjects, and mathematics is a central basis for evaluating scholastic achievement [9]. Alongside this importance, students perceive this discipline as particularly difficult compared to other disciplines and experience more anxiety about it than other subjects [10]. In Israel, where the current study was conducted, the Ministry of Education recently set a goal to significantly increase the number of students studying mathematics at the highest levels [11]. This increase in the number of students in high-level mathematics classes has also increased the scholastic-level heterogeneity and stressed the need to retain students, including students with difficulties, creating additional demands on teachers and influencing the nature of the interactions between them and their students [12].

In many Western countries, including Israel, where the present study was conducted, male students display an advantage over female students in achievements in mathematics, especially at the higher levels of study [13]. For example, among Hebrew speakers (Jewish students whose primary language of instruction is Hebrew), the percentage of male students who excelled in mathematical literacy on the PISA tests in 2022 was 7% higher than the percentage of female students who excelled, and Hebrew-speaking male students scored an average of 18 points more than Hebrew-speaking female students [12]. This gap is also reflected in achievements on the matriculation exams, for example, in 2018, among Hebrew speakers, boys' achievements were 1.7% higher than those of girls in the highest-level track. In addition to the gender gap in achievement, the number of boys taking the high-level mathematics exam compared to girls is also higher. For example, in 2019, 21.8% of male students studied in the high-level mathematics track compared to 17.5% of female students [14].

One possible explanation for this gap might be teachers' perceptions about gender differences in mathematics. However, a review of the scientific literature reveals mixed results. Some studies indicate that teachers perceive mathematics to be a gender-neutral subject and do not believe there are any gender differences between students in mathematical ability [15]. Other studies have concluded that teachers perceive that boys have an advantage in mathematical ability compared to girls [16–19].

1.3. Motivation for Learning

A fundamental aspect that was found to affect student achievement in mathematics is the motivation to learn [20,21]. Students with high intrinsic motivation generally achieve higher in mathematics even when they have to deal with difficulties and failures [18]. With this in mind, it was found that teachers play a critical role in supporting and encouraging motivation for learning in their students [22]. Various studies have found that teachers

who offer support to their students help the development of motivation for learning [23], leading to improved achievement [24]. In addition, the way that the teacher provides the support has an impact on the quality of the motivation that develops in their students [25].

Based on the theoretical framework of Self Determination Theory (SDT), the current study focused on studying how mathematics teachers promote motivation for learning among male and female students who have difficulty learning mathematics by observing discourse simulations.

According to SDT, the various types of motivation differ in their unique characteristics and the degree of autonomy they represent [26]. The type of motivation a person possesses can significantly impact their functioning and well-being. For instance, in the educational domain, students who learn out of inherent interest and enjoyment—exhibiting intrinsic motivation—tend to process information more deeply, persist more in the face of challenges, and ultimately achieve higher outcomes compared to students whose motivation is solely extrinsic [27].

One significance of having different types of motivation concerns the diverse ways in which intrinsic or extrinsic motivation can be stimulated. In the educational context, multiple research findings [28,29] point out how the teacher's approach to motivation can support or alternatively suppress student autonomy. In fact, trying to control a student's motivation inevitably predicts poor learning, behavioral problems, and even dropping out. In contrast, in schools that encourage autonomous motivation, students persist in tasks and their learning is of a higher quality. High intrinsic motivation in students is associated with cognitive achievement and high behavioral and emotional measures [30].

Recent research highlights the importance of teacher support in students' three basic psychological needs—autonomy, competence, and relatedness—as a key factor in improving learning motivation and promoting student independence [24,26,29]. Multiple observational studies have examined the behavioral manifestations of support for basic psychological needs during class [31–34]. The findings of these studies indicate a variety of teacher behaviors that support students' sense of competence, including setting clear expectations, maintaining consistency in class rules, imparting fair and consistent enforcement of discipline, presenting a structured action plan, offering effective feedback, and providing detailed guidance to promote learning while identifying strengths and weaknesses [30,33,35,36].

With regard to supporting a sense of relatedness, studies have identified helpful teacher behaviors such as expressing empathy, taking an interest in students' feelings, and understanding their point of view [32,35]. Supporting student autonomy, the third component, includes behaviors that foster intrinsic sources of motivation, such as respecting students' opinions and suggestions, explaining the rationale for learning in non-coercive language, exhibiting patience, giving time to develop self-motivation, acknowledging negative emotions, and providing choices [35]. In contrast, the suppression of autonomy manifests itself in the use of coercive language, the assumption of a judgmental and rigid approach, the application of verbal and non-verbal pressure, the demand for specific answers or behaviors, and the rejection of the negative emotions of students [33].

In addition, several studies have found that suppressing autonomy and supporting autonomy are separate variables and are not two ends of one continuum, so supporting autonomy does not necessarily imply a low incidence of autonomy suppression, and a teacher can simultaneously present behaviors that support autonomy at a high frequency alongside behaviors that suppress it [34,37]. These findings were taken into account in the present study; autonomy suppression was measured as an independent variable separate from support for autonomy.

1.4. Motivation for Learning and Gender

There are different types of motivation for learning and types of support that are effective for each gender. Thus, one of the consistent findings in the study of motivation

indicates that females tend to have higher intrinsic motivation than males for learning in general, whereas males tend to have higher extrinsic motivation [38–40].

Also, from a motivational perspective, external rewards have little effect on female students [41], and while male and female students reported equal levels of the autonomy they received, female students strive to receive more autonomy than their teachers provide them with in math and science subjects compared to male students [42]. It was also found that girls respond better than boys to teachers' expressions of empathy [43].

Overall, strengthening girls' motivation to learn mathematics is especially important in light of research findings that report that girls have a lower sense of self-competence than boys in mathematics and, accordingly, lower intrinsic motivation and higher levels of anxiety towards mathematics [44,45].

1.5. Personal Conversations as a Tool to Increase Motivation for Learning

Most of the studies examining how to increase motivation have been based on self-report questionnaires [32]. There are also studies that have used direct, in-class observation on encouraging motivation [46–50]. These studies point to the relationship between teacher behavior in the classroom and the motivation of the students.

However, beyond class discourse, it is important to analyze motivation-supporting teacher behaviors that occur during personal (i.e., one-on-one) discourses between teacher and student, since personal conversations based on a "motivational interview model" have been found to be effective in encouraging motivation for learning mathematics [51,52]. A review of 11 studies on the effectiveness of such conversations found them to be particularly significant in improving scholastic achievement [53]. However, it is worth noting that in these studies, conversations took place between students and educational counselors; there are almost no studies that have been conducted regarding similar conversations between students and teachers. Nevertheless, despite the lack of research, various educational bodies, including the Ministry of Education in Israel, have published models and practices for holding personal conversations with students and describe the importance of such a dialogue as a tool to encourage motivation for student learning [54].

The use of simulations in the present study allows for the direct observation of teachers' behavior patterns to support student motivation in personal conversations that are not usually available for observation due to privacy limitations. The use of simulations, as conducted in the current study, therefore enabled us to gather new knowledge that can influence professional development and training processes to help teachers provide optimal support to students with difficulties. Also, by using this knowledge for the simulations, teachers could have the opportunity to practice the required skills. Making the teachers aware of their conversational patterns as they are practicing the skills that the simulation enables can also help narrow the gender gap in classes and balance the gender distribution of female and male pupils who are studying mathematics at the higher levels.

1.6. Purpose of the Study

The current study focuses on simulation workshops designed to promote the motivational discourse between teachers and students, the aim being to examine the types of motivation (intrinsic or extrinsic) that teachers cultivate in their "students", as well as to compare the differences in motivational discourse offered to male and female students. Thus, simulation workshops can enhance mathematics teachers' skills for increasing student motivation for learning. The research hypothesis was that a bias would be found in favor of the male students, to whom teachers would tend to provide more motivational support for relatedness, competence, and autonomy. Accordingly, it was hypothesized that teachers would suppress girls' autonomy more often than they do for boys.

2. Materials and Methods

2.1. Participants

The study involved 29 middle school mathematics teachers affiliated with state schools who follow the national math curriculum. These schools are comprehensive, and each school has classes for high-level math students. The teachers participated voluntarily in a simulation workshop as part of a continuing education course for mathematics teachers on the subject of innovative pedagogy in teaching mathematics. The continuing education leader invited the teachers to participate in this study as part of the workshop. All the teachers voluntarily gave their consent for the study and agreed to participate in the simulation workshops.

Of the 29 participants, 26 were female (89.66%), 13 taught in state schools (45%), 11 taught in state-religious schools (38%), 1 teacher taught in an ultra-Orthodox school (3.5%), 3 teachers taught in an Arab school (10%), and 1 teacher taught in an "other" stream (3.5%). More than half of the teachers (n = 16, 55%) taught classes with 20–25 children and the remaining 13 (45%) taught larger classes of 30–35 children. The number of students and the percentage of female teachers in the workforce reflect the demographic situation in Israel [55]. Out of the 29 teachers, 13 (45%) hold roles other than teaching mathematics, such as home-room teacher, grade coordinator, or subject coordinator.

Seven of the teachers (24.1%) have 2–4 years of experience, fifteen (51.7%) have 6–12 years of experience, and seven (24%) have 18–37 years of experience.

All teachers have a teaching certificate and 19 of them (61%) hold a bachelor's degree in mathematics or teaching mathematics.

2.2. Tools

2.2.1. Questionnaires

A demographic questionnaire included personal questions such as age, years of teaching seniority, degrees in mathematics, and teaching certificate.

2.2.2. Analysis of the Simulation Videos

The interactions between teachers and "students" were videotaped for analysis. The research literature e.g., [56] identifies many advantages of video analysis, as it allows authentic observation that provides detailed and varied information about complex social situations. Moreover, it allows the exposure of different patterns of behavior while overcoming the existing gap between self-report and actual occurrence [57,58]. A total of 29 videos were filmed, each of which comprised 6 min of teacher–student discourse.

The encoding of the simulations was carried out using observer XT 15 software and consisted of five stages.

Stage one: Determining the criteria for observation. Observational analysis was conducted based on principles of observation to identify SDT motivational aspects during the sessions [32–34]. In order to code the support teachers give for each of the three students' needs during a conversation, the present study uses a unipolar measurement scale developed and validated by [59], which takes into account that autonomy suppression is a separate variable that is not related to supporting autonomy. We thus tested all four behaviors independently on a scale ranging from 1 (very small extent) to 7 (very large extent).

The measurement scales upon which we relied [31,33] were designed to analyze pedagogical discourse in a classroom lesson. In order to adapt them to observing the individual interpersonal discourse of teacher–student encounters focused on motivation for learning, those sections that were appropriate to the lesson, such as teaching and practicing material, providing feedback on concrete learning problems, and guidelines related to the classroom lesson, were deleted. Appendix A presents the criteria that were checked.

Stage two: Preliminary analysis of videos. The preliminary study included viewing five simulation videos in which a teacher held a dialogue with a student to enhance their motivation. These five simulations were not included in the framework of the study

and were only used as an aid in formulating observational criteria for the following four variables: supporting autonomy (e.g., clarifying the student's goals and objectives, prioritizing the student's wishes, and providing optimal choices); providing students with a sense of competence (e.g., setting clear optimal goals, setting intermediate goals, assisting in coping with failure, focusing in a process rather than a grade, providing a clear plan of action); providing a sense of belonging and closeness (e.g., reflecting feelings and needs, expressing empathy, interest and caring); and behavior that suppresses autonomy (e.g., use of coercive and controlling language, elimination of the desires, priorities, needs, and feelings of the student, use of punishments and rewards).

Each behavior was scored to reflect its intensity on a scale from 1 (very little) to 7 (very much), similar to the observation analysis scale in class (Stage 1).

Stage Three: Validation. We validated the coding by having two observers watch six randomly selected simulation videos and checking the coding reliability of each. One of the observers was a master's student in educational counseling and the other was an educator with a rich background in the field of simulation as a content developer and workshop facilitator. After encoding two videos together, they encoded eight videos separately and the reliability was tested considering the type and intensity of the support observed. This procedure builds on previous observational studies that tested reliability using multiple observers [60,61]. The actions that increase the validity of event analysis are not possible with live observations of events that cannot be reproduced [62]. An analysis conducted to examine the reliability between the observers produced a value of 0.76 (Cohen's kappa) for the type of support the teachers provided (support for autonomy/support for competence/support for relatedness) and a value of 0.65 (Cohen's kappa) for the intensity of the behavior.

Stage Four: At this point, the analysis encompassed 29 simulation videos, from which 870 motivation-supporting responses were identified and coded according to the predetermined observation criteria. Each video was evaluated across four dimensions, yielding four distinct scores per simulation. Table 1 presents sample statements reflecting the different categories for analyzing the discourse between teachers and students.

Table 1. Examples of statements divided according to category.

Motivational Category	Sample Statements
Supporting autonomy	• It's your decision how much to invest in studying math. • What interests you to do when you grow up? Do you think studying high-level mathematics will help you? • How much do you want to be in Group A and succeed?
Supporting competence	• You were good, you stayed the same person, I know you're good. • Your mathematical ability has not changed. • The school offers private tutoring if you want.
Supporting relatedness	• I'm here with you. • I'm here to help you with whatever you need. • How are you doing and feeling?
Suppressing autonomy	• You can't make an informed decision now. • Is that what you think? Should I let you move down to a lower level? I allow you?

2.3. Research Procedure

Prior to the current study, the teachers participated in an online group simulation workshop as part of a professional development course titled, "Innovative Pedagogy in Teaching Mathematics in Middle Schools". At the start of the workshop, the teachers were asked to fill out a form for demographic information and a request for consent regarding participation in the study, to which they all responded positively.

The simulation workshop comprised two simulation events of 5–7 min each per participant, in which they engaged in a conflictual event with a professional actor (sometimes male, sometimes female) portraying a student. Each event was videotaped. After each

encounter, a video-based debriefing was conducted to examine the needs, feelings, and perceptions of the teacher and the student during the discourse and to point out communication skills that did or would have advanced the teacher's goals. Each debriefing included all the workshop participants, thus allowing peer feedback alongside the actors' feedback regarding their feelings during the interaction and the teacher's actions that met their needs.

During the week following the group workshop, the teachers participated in individual online (via Zoom) simulations based on a new conflictual scenario (that is, different from the scenarios of the group workshop). These simulations form the basis for the present research. In contrast to the group simulation workshop, the individual simulation took place with the actor representing a student but without the presence of a group of teachers or the facilitator, meaning that there was no discussion or peer learning. Fifteen of the teachers, chosen at random, performed the simulation with a male actor playing a male student. The remaining 14 teachers performed it with a female actor playing a female student.

Each teacher received the following preliminary data, explaining the simulation event:

You are a middle school mathematics teacher. Among other things, you also teach the highest level of mathematics in grade 9.

Romi is a student in your class. Last year, Romi had good grades. She was popular in her class and was always hanging out with friends.

At the beginning of the year, Romi arrived fully motivated to succeed in math, but lately, there has been a change in her behavior. Sometimes she doesn't do her homework and she doesn't participate in classes as much. You are concerned that Romi is not fulfilling her duties as a student at Level A and gaps in learning that will be difficult to fill are being created. In the tests that she took lately, Romi scored lower than usual, and she failed last week's exam. At the end of the last lesson, you overheard her telling her friend that she is considering moving to Level B.

You thought it would be beneficial to invite her to talk about her academic situation. Now, you are meeting with Romi.

After reading the opening data, a 6 min simulation took place between the actor and the teacher, after which each teacher answered 3 guiding questions for personal reflection. Once the responses were recorded, the actor gave feedback to the teacher on the actions the teacher took during the simulation that would help or hinder a student.

It should be noted that preliminary analyses were conducted to rule out the possibility that gender bias was the result of differences between the male and female actors. For this purpose, their behaviors were compared by a research assistant who was a veteran female actor at the Simulation Center. A large part of her training and work at the center includes providing opportunities for teachers to experience various situations with her. She was asked to focus on the actors' responses and count the opportunities for teacher support that the female actor gave the participant compared to that of the male actor in a random sample of six videos. In each video, she counted between 4 and 14 sentences demanding support. Example sentences are as follows: "My grades aren't so good", "Maybe I'm not as good as I thought", "Maybe I'm simply not suitable for Level A", "I'm not happy with my grades", "It's not that I don't try". The average number of support opportunities the male actor offered in the three simulation videos was 8.30 sentences (SD = 5.13)], while the average number of support opportunities in the female actor's videos was 8.60 sentences (SD = 3.22). Examining differences between these values revealed no statistical significance ($p = 0.41$), i.e., there was no significant difference between the number of support opportunities offered by the male and female actor.

3. Results

Preliminary analysis. To analyze the simulation videos, we used a set of statistical tools. First, we performed a general scan of the various motivational statements and listed their frequencies and relative frequencies. To draw a preliminary impression of

these motivational types, we compared each actual proportion with an expected balanced proportion (one for each of the four types, 25%). At this stage, we observed the motivation types with respect to male versus female students. We applied the Pearson's χ^2 test for categorical variables and the two-proportion Z comparison test [63]. For further analysis, we developed binary and multinomial logistic regression models, which were controlled by the teachers' repeated measures, that is, two-level logistic regression models [64,65]. This means that measurements had two sources of variation, within-teacher and between-teacher. The binary logistic regression modeling approach means that the outcome variable was distributed as "1" if a specific motivational type was preferred, and "0" otherwise. The multinomial approach expands this distribution to testing each motivation type versus the other alternatives.

Frequency analysis of the various motivational types: overall approach. The first research question related to the types of motivation that teachers encouraged. Findings show that teachers supported autonomy and competence more than they suppressed autonomy and supported relatedness. Table 2 shows these comparisons. Supporting autonomy and competence had similar frequencies (32.4% and 35.9%, respectively; $Z = -0.75$, $p = -0.450$). Similarly, suppressing autonomy and supporting competence showed no significant difference in frequency (12.0% vs. 19.8%, respectively; $Z = -1.68$, $p = 0.096$). However, supporting autonomy and competence were found to differ significantly from the proportional use of suppressing autonomy and relatedness (suppressing autonomy: $Z = -4.02$, $p < 0.001$; $Z = -4.61$, $p < 0.001$; relatedness: $Z = 2.92$, $p = 0.004$; $Z = -3.69$, $p < 0.001$). These results were found to align with Benjamini and Hochberg's adjustment for false discovery rate [66]. In addition, a χ^2 test to check whether the observed proportions confirm the null hypothesis (i.e., the relative rate of each type will be 25% equally) showed that the null hypothesis was rejected ($\chi^2(3) = 128$, $p < 0.001$). Figure 1 shows the frequencies and proportions of the different behavioral types.

Table 2. Multiple pairwise comparisons across motivational types' relative frequencies [1].

Behavioral Type	Proportion (S.E.)	Final Rank	(2)	(3)	(4)
Suppressing autonomy	12.00% (3.2%)	a	$Z = 4.02$ $p < 0.001$	$Z = -1.68$ $p = 0.096$	$Z = -4.61$ $p < 0.001$
Supporting autonomy (2)	32.41% (2.8%)	c		$Z = 2.92$ $p = 0.004$	$Z = -0.75$ $p < 0.001$
Supporting relatedness (3)	19.77% (3.0%)	b			$Z = -3.69$ $p < 0.001$
Competence (4)	35.86% (2.7%)	c			

[1] Note. Latin letters for ranking, "a" for the lowest proportion and upward.

The next question related to the teachers' support for male versus female students. Figure 2 presents the same motivation types grouped by gender. From Figure 2, we learn that events concerning relatedness were higher among male students ($p = 0.007$); with respect to the other motivation types, no significant gender difference was noted. Table 3 shows these test results in a more detailed form.

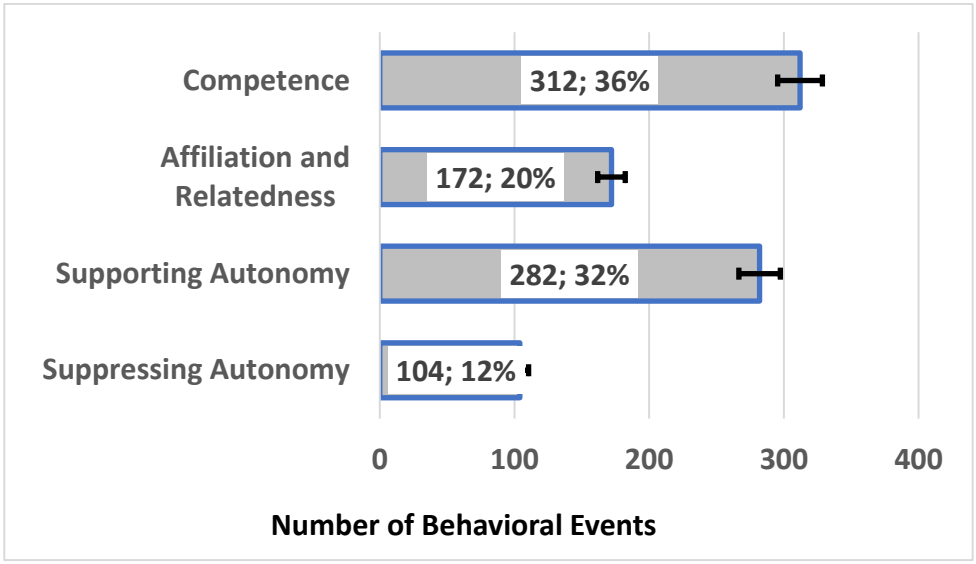

Figure 1. The distribution of motivation supporting behaviors. Note. Error bars for 95% confidence interval based on proportion standard errors.

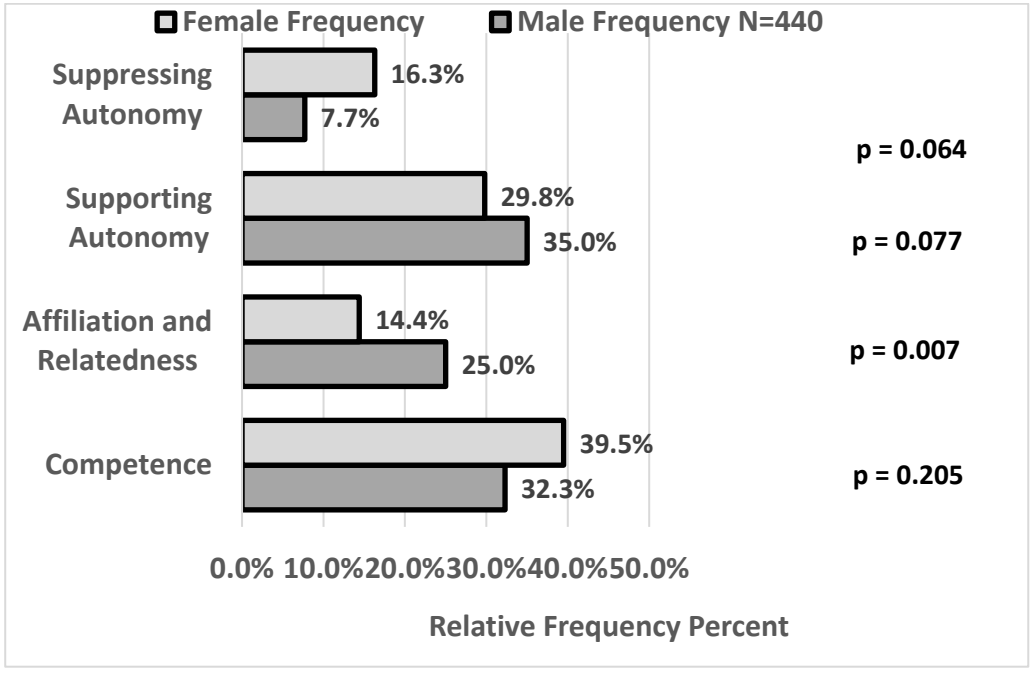

Figure 2. Distribution of motivation types by gender. Note. *p*-values represent two-proportion comparison Z test results in each motivation type.

Table 3. Proportion of motivation types used among teachers by gender [1].

Behavioral Type	Female Frequency (%)	Male Frequency (%)	Difference (*p*)	Z Value [95% CI]
Competence	170 (39.5%)	142 (32.3%)	7.3% ($p = 0.032$)	−2.14 [1.0%, 13.9%]
Relatedness	62 (14.4%)	110 (25.0%)	10.4% ($p = 0.002$)	3.12 [3.9%, 17.2%]
Supporting autonomy	128 (29.8%)	154 (35.0%)	5.2% ($p = 0.123$)	1.54 [−1.4%, 11.9%]
Suppressing autonomy	70 (16.3%)	34 (7.7%)	8.6% ($p = 0.012$)	−2.52 [1.9%, 15.2%]

Results, two-level logistic regression model. Next, we show the modeling results, which integrated the teacher's behavior as level 2, that is, motivational statements toward male in comparison to female students were not independent of the specific teacher. For this analysis, we added a strength scale for teachers' behavior (1, lowest; 7, highest). Overall, the greatest difference with respect to gender was observed in suppressing autonomy ($p = 0.031$); none was found for the other types, as shown in Figure 3. This additional analysis was expected to improve our understanding of the support as is perceived by the students.

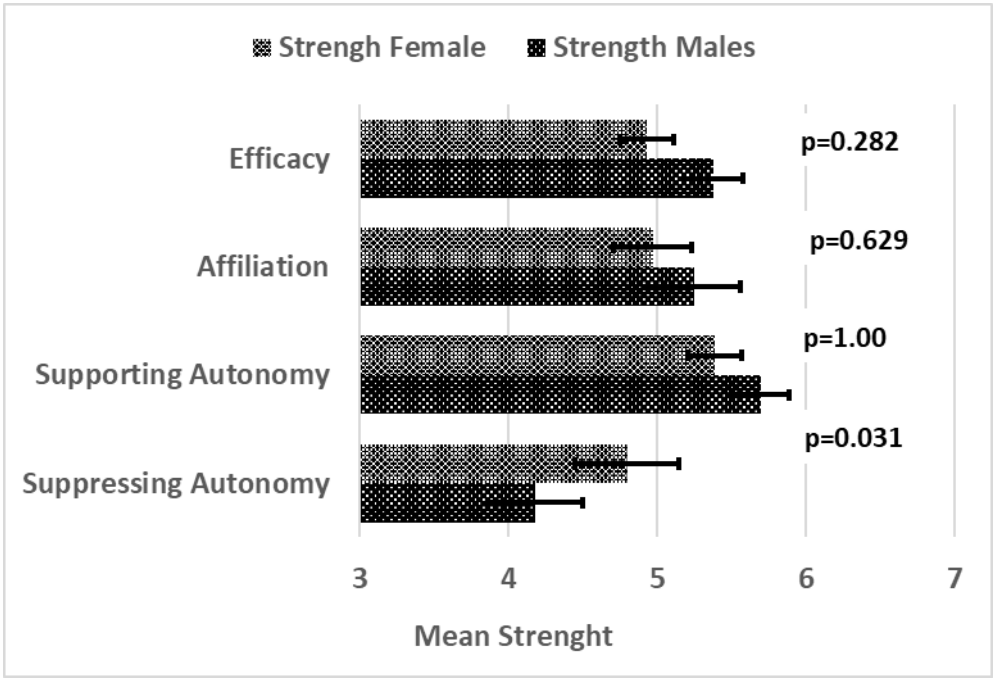

Figure 3. Gender effect on strength across motivational types. Note. Standard errors in parentheses.

To test the strength scale within the two-level model framework, we show a preliminary two-level analysis in Table 4. This included the motivational types (suppressing autonomy was set as the reference category) as indicators of power at the measurement level (L1) and gender at the teachers' level (L2). In terms of power, supporting autonomy was higher in comparison to suppressing autonomy (b = 0.86, $p = 0.003$), but other motivational types showed no difference in power in comparison to suppressing autonomy, nor was there any gender effect at level 2. Interestingly, in comparison to suppressing autonomy, competence was found to be lower among female students than male students (b = −0.89, $p = 0.043$). These differences are shown in Table 4.

We tested the strength and gender effects within a multinomial logistic regression model, in which the outcomes showed which motivation types were preferred (see Table 5). Gender differences were also included as a factor at the teachers' level (level 2). The three binary outcomes referred to suppressing autonomy. Strength showed an effect on the probability to prefer encouraging behavior over behaviors that suppress autonomy (ODDs = 1.76, $p = 0.001$), that is, the probability of supporting autonomy was 1.76 higher in response to a unit change in strength. The probability of encouraging relatedness over suppressing autonomy was lower among female students in comparison to male students (ODDs = 0.29, $p = 0.013$) by 70 percent (1 − ODDs). The interaction term was found significant with respect to the probability of supporting competence in comparison to suppressing autonomy (ODDs = 0.53, $p = 0.019$). This means that the difference in the probability of offering behavior to support competence was lower among female compared to males by 47 percent.

Table 4. Two-level regression model explaining the strength scale variation, main effects, and interactions.

	***p*-Value**	**b (SE)**
Main Effect Model		
Level 1		
Supporting autonomy	0.86 (0.29) [1]	0.003
Relatedness	0.41 (0.28)	0.147
Competence	0.50 (0.26)	0.054
Residual Variance	1.34 (0.10)	<0.001
Level 2		
Gender	−0.22 (0.19)	0.237
Intercept	4.76 (0.28)	<0.001
Residual Variance	0.22 (0.09)	0.016
Interaction Model		
Level 1		
Gender X Supporting autonomy	−0.75 (0.52)	0.151
Gender X Relatedness	−0.66 (0.50)	0.182
Gender X Competence	−0.89 (0.44)	0.043
Residual Variance	1.33 (0.10)	<0.001
Level 2		
Intercept	4.30 (0.29)	<0.001
Residual Variance	0.22 (0.09)	0.016

[1] Note. Standard errors in parentheses.

Table 5. Multinomial logistic regression results, model estimates, and ODDs multipliers.

	Autonomy Support	**Relatedness**	**Competence**
Model 1 Main effects			
L1 Strength	b = 0.57 (0.17) ODDs = 1.76, *p* = 0.001	b = 0.27 (0.17) ODDs = 1.31, *p* = 0.108	b = 0.29 (0.15) ODDs = 1.34, *p* = 0.051
L2 Gender	b = −0.76 (0.52) ODDs = 0.47, *p* = 0.144	b = −1.23 (0.50) ODDs = 0.29, *p* = 0.013	b = −0.47 (0.44) ODDs = 1.33, *p* = 0.285
Intercept	1.46, *p* = 0.120	−0.18, *p* = 0.850	−0.02, *p* = 0.978
Model 2 Interaction			
Strength * Gender	b = −0.56 (0.33) ODDs = 0.57, *p* = 0.090	b = −0.52 (0.32) DDs = 0.60, O *p* = 0.105	b = −0.63 (0.27) DDs = 0.53, O *p* = 0.019
Intercept	−3.16, *p* = 0.008	−1.75, *p* = 0.145	−1.93, *p* = 0.039

Note. Autonomy suppression is the reference category. Standard errors in parentheses.

4. Discussion

The aim of the study was to investigate the use of simulation workshops designed to enhance motivational discourse between mathematics teachers and struggling students who have difficulty keeping up with the curriculum, especially in advanced mathematics, and to examine possible differences in the type of support offered to boys compared to girls. This is against the background of the theoretical framework of SDT, according to which intrinsic motivation and individual well-being require an environment that supports the three psychological needs of the individual, autonomy, competence, and relatedness [24,26,29].

The findings of the study indicate that there is, indeed, a difference in the types of support that teachers provide to students in general, and that support for autonomy rated higher than support for relatedness, although it was similar to the support for competence. Coercive and oppressive behavior had a low prevalence—that is, among all teachers, support for intrinsic motivation was higher than support for extrinsic motivation. It is possible that the teachers' support for intrinsic motivation over extrinsic motivation is related to the fact that the teachers who participated in the study were experienced teachers who tend to allow their students more autonomy and believe they can conduct their classrooms in a less authoritarian manner and give their students more choices [67,68].

A possible explanation for the high prevalence of support for autonomy might be that teachers were aware that the student they were addressing had the ability to succeed in advanced-level mathematics. This complements previous findings that teachers tend to allow more autonomy to students with high scholastic abilities compared to how much autonomy they grant to students with lower learning abilities [69]. It also complements another study that found that teachers believe that students with intrinsic motivation are deserving of more autonomy, and that the teaching method needs to be more coercive with students with low motivation for learning [70]. Perhaps teachers believe that they must offer more support for students who have extrinsic motivation and low ability because their lack of competence impairs their intrinsic motivation.

Another key finding was the significant difference in teachers' support of boys' motivation compared to that of girls; teachers gave more support for relatedness to boys than to girls. This finding supports the research hypothesis and corroborates previous studies that indicated that female students respond better than male students to teacher-given empathy [43]. Despite this, the amount of empathy and interest that the girls received was significantly lower than the prevalence of support for the relatedness that the boys received from the teachers.

This unique finding ties with previous findings on how gender differences and teacher behavior play out within the context of the classroom climate. For example, various studies have indicated that boys tend to interfere (i.e., exhibit disruptive behavior) more in classes than girls [71,72] and that these interferences have an impact on the increased attention boys receive from teachers compared to female students, especially in classrooms with a poor classroom climate. In these classes, the gaps in mathematics achievement between boys and girls are particularly noticeable [73]. It is possible that such aspects of class climate and gender-dependent behavior are related to the fact that teachers tend to offer more support in relatedness and autonomy for male students, as they might be behaving as such to foster a personal connection with the boys to help them cope, in general, in the classroom.

Another aspect that may explain the gap in support for relatedness that teachers gave male students compared to female students may be connected to previous findings that have indicated that teachers may perceive boys to be more competent in mathematics and more capable of succeeding than girls [16–19] and therefore teachers unconsciously tend to invest more in them—emotionally too. Follow-up studies should examine the perceptions of those specific teachers that exhibit positive bias toward boys and offer more support for relatedness, based on other studies in which teachers expressed declared egalitarian attitudes regarding gender ability in mathematics [15].

The current study also found a trend indicating a higher prevalence of granting autonomy to boys compared to girls and, accordingly, a higher prevalence and intensity of suppressing autonomous behaviors towards girls compared to boys. Indeed, a previous study found that teachers tent to support the autonomy of students they perceive as more competent [69], and it is possible that the teachers who participated in the current study supported the autonomy of male students more than female students because they perceived the male students to be more competent in mathematics. The discriminatory treatment that female students receive with regard to support for their autonomy may make it even more difficult for them to improve their achievements in mathematics. This is

especially concerning against the background of studies that have found that girls' need for autonomy is higher than that of boys [42], and, given the findings of this study, it appears that this need is not being adequately met.

The findings are relevant to mathematics pedagogy and emphasize the contribution of a focused simulation exercise, designed to meet the unique needs of this discipline, in exposing the tacit knowledge that can affect the training and professional development processes of mathematics teachers, as well as in reducing any gender gaps in this field that can lead to long-term social and emotional effects.

The findings of the study also reinforce the understanding that simulation-based learning can be an effective pedagogical tool for enhancing teacher training and professional development processes [74], and that it possesses unique characteristics in this area. Its main advantage is that if offers a combination of practice and experience in key teaching practices in a protected and enabling learning environment, which has the ability to promote in-depth processes among teachers [75]. Specifically, the current study points to a unique opportunity inherent in individual simulations during training and professional development processes and strengthens our understanding of how simulation exercises can contribute to signature pedagogy in teacher training [76]. The experience of undergoing an individual simulation that enables interpersonal dialogue is a unique opportunity for learning and training. First, it offers the teacher the chance to experience in-depth reflective observation of the gap between their declarative statements regarding their level of egalitarianism and how it is actually expressed in authentic events that are observed and documented. In the current context, simulation is of particular importance because, while teachers tend to declare egalitarian attitudes towards their students, the simulation exposes hidden motives that are less reflective of egalitarian attitudes. Simulation provides an opportunity to enhance teachers' awareness of their perceptions and attitudes, as well as how these influence their behavior toward students. It also reveals underlying and less acceptable motives, encouraging teachers to critically examine attitudes and behaviors of which they may not be fully aware of. It is important to note that in training and professional development processes, personal discourse between teachers and their students is a subject that receives only limited research attention, despite its great importance in establishing trusting and close relationships between them. Undergoing an experience of meaningful intimate discourse, such as that described herein, is essential for pre-service teachers who have not yet had the opportunity to experience close personal dialogue with students. This is an important and significant aspect for improving their readiness for the educational field, where interpersonal conversation with students is of great importance. Experienced teachers can also gather a lot of information about how they react in complex events, and exercises such as those described are especially useful in allowing them to break down automatic response patterns and to restructure appropriate responses. In this way, such simulations may promote gender-sensitive teaching and deepen teachers' understanding of gender issues in the classroom.

One of the unique characteristics of simulation training is the feedback that participants receive from the actors and that this feedback is provided in real time. This allows them to conduct an immediate reflection to examine the beliefs and attitudes that underlie their behavior [77]. In addition to revealing behavior patterns, simulation allows acquiring and practicing vital skills to optimally motivate struggling students according to their gender needs. The opportunity to experiment with and practice specific actions that motivational theory has found valuable highlights the importance of simulation as an effective tool that bridges theory and practice and enables the promotion of gender-appropriate teaching, all under benign conditions that allow teachers to go out into the field more prepared.

Study Limitations and Follow-Up Studies

Despite the contributions made by the current study, it is not without its limitations. It should be noted that the simulation exercises were conducted online via the Zoom platform. Teachers may behave differently when they are in a face-to-face conversation with their

students. For example, in a study conducted during the COVID-19 crisis, it was found that mental health therapists expressed less empathy and warmth in online meetings than in face-to-face meetings [78]. Another study [79] carried out in a school found that only 24% of students experienced online classes as an empathetic learning experience and emphasized the need to establish empathy in teachers who teach online. It is possible that in face-to-face meetings, teachers are more sensitive to subtleties and behaviors that are not revealed during a remote meeting (via Zoom) and therefore their mode of support is different from that expected. More specifically, it is possible that when teachers converse on Zoom, their emotional discourse is shallower due to the medium, and therefore support for relatedness was lower than support for competence and autonomy. Thus, despite the growing use of digital platforms in schools and how conversations such as those that took place in the simulation experience do actually take place, any generalization of the findings to include face-to-face conversation should be made with caution. Additionally, follow-up studies in which face-to-face simulations are examined should be conducted. Because of the distinctions in social and emotional context, technological mediation, and the nature of engagement, findings from digital environments may not fully capture the nuances of face-to-face conversations, making it important to avoid broad generalizations. In addition, for future research, we recommend enhancing the generalizability of findings through several methodological improvements, such as increasing the sample size, including more male participants to achieve better gender representation, and expanding the measurement instruments to capture a broader range of variables and contexts.

5. Conclusions and Recommendations

In conclusion, the findings of the present study contribute a unique perspective to the existing knowledge regarding the way teachers can enhance their students' motivation to learn mathematics, particularly in the context of gender. This is achieved by understanding the support that mathematics teachers give students during personal conversations, while expanding the explanations for the existing gender gap in mathematics achievements. Collecting data based on the direct observation of simulation workshops sheds light on situations that researchers usually do not have access to and paves the way for further research in the field of personal discourse between teacher and student as a tool for increasing motivation. Such simulation workshops also allow focusing on situations specially adapted for the specific field of knowledge, and direct observation enables understanding complex phenomena in more depth and exposes the hidden behavior patterns of teachers. Exposing such patterns, along with giving teachers the opportunity to practice skills that can optimally support the motivation of struggling students according to their gender needs, emphasizes the importance of using simulations as a tool in teacher training and professional development processes as well. Thus, this study highlights the significant potential of clinical simulation in teacher training and professional development. It is important to note, however, that teacher–student interactions in the classroom are extensive and diverse, spanning long periods and covering a wide range of topics. Simulated practice allows for the isolation of specific events and focuses on particular behaviors for the purposes of learning and practice, which is one of its key advantages. Simulation offers a valuable opportunity to practice the management of sensitive issues and individual conversations and serves as a focused tool for formative assessment and a foundation for intervention programs aimed at both trainee teachers and experienced educators. Through these simulations, teachers gain insight into their own beliefs and can practice overcoming inherent biases with targeted, hands-on experience in real-world scenarios.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Observation Criteria

	1 (Very Low)	2	3	4	5	6	7 (Very High)
Behaviors that support autonomy							
Determine goals, aims, and feelings of student							
Reflect goals that the student has defined							
Providing information and rationale for studying the subject							
Prioritizing the student's wishes							
Providing optimal choices							
Behaviors that suppress autonomy of coercion and stress							
Coercion: Use of dominating language (you must/should)							
Eliminating desires, priorities, needs, and feelings of the student							
Prioritizing teacher's goals and wishes							
Use of penalties, threats, rewards							
Behaviors that support a sense of competence							
Clear optimal goals							
Intermediate goals							
Assistance in dealing with failure—process rather than grade							
Clear plan of action							
Highlighting strengths							
Behavior supporting relatedness							
Reflecting feelings and needs							
Expressing empathy, interest, and caring (offering help, in-depth questions, personal acquaintance, and legitimizing the emotions expressed)							

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