



Mathematics for a Better World: Promoting Social Values in Mathematics Education

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Mathematics for a Better World: Promoting Social Values in Mathematics Education

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Abstract

Social values are integral part of the norms that are emphasized into the educational systems, and their integration in the school curricula is essential for nurturing responsible citizens. The current paper discusses the outcomes of learning social values within mathematical content and problem solving. The research was conducted in an academic course that social values was one of its topics. The participants were 18 pre-service mathematics teachers who study in an Arab college in Israel. They underwent a training process in studying social values within mathematical content and subsequently applied it in schools. Employing qualitative methods, the research examined how to integrate social values in mathematics class, and how the pre-service mathematics teachers evaluate the importance of the subject. The findings indicated a notable improvement in the pre-service teachers' interest in the subject even it was a challenging experience. They realized that integrating social values into mathematical content is possible and applicable to various mathematics subjects. The findings may contribute to highlight the importance of integrating social values into mathematical content both at schools and at the academic education institutions.

Introduction

Mathematics education should answer needs of the 21st century. Educating for social values in school is essential for nurturing responsible citizens, but it's generally perceived as a component of the education class, in contrast to subjects like mathematics, which hardly emphasize this aspect (Movshovitz-Hadar & Edri, 2013). mathematics teachers, as educators, should find the connection between the subject matter and the incorporation of social values into mathematical content. it's a challenge mission that requires additional effort from the teacher (Bartell, 2013). Researchers in mathematics education highlight the importance of integrating social values into mathematics class to enhance learning (Bishop, 2008; Ernest, 2012) and nurturing responsible citizens. However, research in this field is still underdeveloped (Movshovitz-Hadar & Edri, 2013), with more emphasis on the emotional aspect of values. Research should support mathematics teachers in implementing social values in class (Mamolo, 2018).

In line with the 21st century required skills (Gravemeijer, et al., 2017), mathematics curricula for school in Israel focus on developing cognitive abilities, nurturing problem-solving skills, acquiring mathematical concepts, enhancing proficiency in the subject matter, and realizing the full potential of learners. Yet, including social values

in these curricula and mathematical content is not emphasized enough, leading mathematics teachers to neglect highlighting social values in their lessons (Seah, 2016). Recognizing the importance of the subject, the ministry of education in Israel has undertaken a comprehensive examination of values education and has actively incorporated this topic into the educational system (Dichter, 2015). Consequently, teacher training institutions must adopt the theme of values education and integrate it into various teaching domains, including mathematics (Movshovitz-Hadar & Edri, 2013), by developing appropriate teaching materials. But in practice the recommendations were not implemented.

In line with this perspective, the subject of social values has been integrated into the academic course "Planning Curricula in Mathematics" at the Academic Arab college for education in Israel, for prospective mathematics teachers, that taught by one of the authors. One of the course topics deals with the integration of social values into mathematics class through activities and problem-solving practicing that introduce situations in a values context. After learning about the topic in the course, the pre-service teachers implemented social values in mathematics classrooms during their training at schools. Thus, an opportunity arose to involve prospective mathematics teachers in a new experience for them. This research aimed to answer the question: In what way social values can be integrated in mathematics class?

Theoretical Background

Education for Social Values

A value is an ideal that relates to desires, preferences, moral righteousness, or the potential benefit of specific actions or goals (Tsirogianni & Gaskell, 2011). The concept of value is considered as part of social norms, gaining comprehensive consensus as either a good or desirable value. Social values form an order in a collective in what is acceptable and not acceptable, and what is desirable or non-desirable. Schools educate students and prepare them to live in the society as an active and positive citizen. The importance of this subject that was not emphasized enough in schools led the Ministry of Education in Israel to establish a committee in 2017 called the "Committee for the Promotion of Values Education" (Naiman & Tzachor, 2017). It investigated deeply into values education and determined rules for actively implementing this topic within the education system. In the detailed document published by the committee, there is a broad reference to content in various subjects, including questions in the matriculation exams where students are required to express their position related to ethical and social values.

According to the goals of the committee (Naiman & Tzachor, 2017), there are different definitions of social values, but three main characteristics can be distinguished: 1) values are inherent ideals; 2) they serve as criteria for evaluating phenomena and actions; and 3) they are principles that guiding our behavior. Values provide meaning to people's lives and can serve as a bridge between the individual and society as a whole (Corey & Ninomiya, 2019).

However, there are various approaches to values education, which depend on the educator's intended goal. Every teacher is an individual educator. Ultimately, a decision must be made regarding whether the goal is to effect real change in the behavior of the learner, leading to the adoption of a shaping approach, or to encourage thought and

develop reasoning, which calls for a stimulating approach. Each approach requires an appropriate method of action to achieve the goal within the existing educational framework.

Social values may cultivate a moral resilience in the learners, which is expressed in a sense of responsibility and the development of critical thinking about what is right and what is wrong. They direct the learner act according to moral standards and social norms and help them cope with situations involving ethical dilemmas (Baratz, 2015). Therefore, the education system should work to strengthen ethical resilience among students as a means of shaping their worldview. Continuous educational activities and the creation of a supportive environment within the school will assist learners in developing ethical resilience, enabling them to find resources to deal with ethical dilemmas effectively.

In the Arab society in Israel, social values still hold a significant place despite undergoing the process of globalization. Values such as solidarity in times of joy and sorrow, support for extended family members, mutual respect in human relationships, and respect for parents and their care, are part of the norms that characterize the Arab society (Jaraisy, 2021). As a traditional society, it preserves some of the values and norms of its heritage, and as an ethnic minority in the country, it adopts and instills some of the values of the general population (Khalaila & Litwin, 2011).

Education naturally plays an essential role in the modernization process that Arab society in Israel is undergoing. This has led to the development of proactive action plans within the education system for conveying social values and cultural codes (Azaiza et al., 2008). Therefore, the report of the Committee for the Promotion of Values Education in the Ministry of Education specifically addresses values education in Arab society (Naiman & Tzachor, 2017). One of the fundamental components of the report is related to "Heritage Values and Arab Culture in Arab Society". In the intervention and implementation program, more than forty Arab elementary schools participated in the systemic perception of values education. The program included training on values and the preparation of instructors for the integration of social values into various subjects.

Social Values in Teacher Education

Teacher education should be aligned with the needs of educational institutions and the 21st century skills required of every graduate in the education system who connects theory to practice and prepares teachers for the realities that the education system deals with. One of the challenges that the education system currently faces is a lack of tools for preserving social values and behavioral norms. According to the perception of the Ministry of Education (Naiman & Tzachor, 2017), the changes that society undergoes in the modern era cause social values to change according to age, life experience, relationships with others, and more.

The role of the educators is to assist their students in the process of learning social values to improve their lives and develop their responsibility to society and positive involvement in it. The goal is to impart values and behavioral guidelines and prepare students to fulfill a positive role in society as ethical individuals. Teachers need to pass on positive values to the next generation and instill them in their students for the benefit of society.

Additionally, values education, as part of the educator's agenda, can help students develop the ethical resilience required to deal with moral dilemmas (Baratz, 2015). Therefore, teacher training institutions need to adopt the subject of social values education and integrate it into various teaching domains (Movshovitz-Hadar & Edri, 2013) by developing appropriate teaching materials.

Focusing on values resilience in the teacher education process is especially important among students from minority groups (Baratz, 2015). Teacher education should prepare future educators to be part of a developing modern society and as educators in the 21st century (Dichter, 2015). They should see values education as an essential part of their role, capable of dealing with ethical issues, creating opportunities for value exploration, and enabling students to develop their unique identity by respecting the others. Therefore, teacher education institutions should be able to prepare teachers for their future roles with a strong foundation in values education. Values education needs to be an integral part of the curriculum and daily activities in teacher training institutions, allowing each institution to emphasize the appropriate values for its learning community.

Social Values in Mathematics Education

The curriculum for mathematics education emphasizes the development of learning abilities, the acquisition of mathematical concepts, and the cultivation of learning skills. While these curricula emphasize maximizing the students' potential in mathematics (Gravemeijer, et al., 2017), the focus on education for social values is not adequately emphasized in the learning objectives and mathematical content.

According to Vinner (2009), mathematics education has long been dealing with social values that teachers should be aware of and capable of addressing. Consequently, mathematics teachers, in addition to their role as educators, should find the connection between the subject matter and the incorporation of social values into mathematical content. Researchers in mathematics education (Bishop et al., 2003; Daher, 2020; Seah et al., 2016) have highlighted that mathematics educators are placing more emphasis on developing problem-solving skills and nurturing creativity.

As a result, the curricula have paid less attention to the cultural and social aspects, which are hardly emphasized in the mathematical content. The absence of such content does not guide mathematics teachers to emphasize social values in their lessons (Seah, 2016). On the other hand, some mathematics teachers do not see it as their responsibility to emphasize social values or claim that there is not enough time in the mathematics lesson due to the curriculum's content load or argue that they were trained to teach mathematics and not to teach social values (Muvshovitz-Hadar & Edri, 2013). Researchers in mathematics education have referred to values in mathematics lessons in an emotional context, considering their cultural and social significance for individuals (Seah & Bishop, 2001). Values are inherent in mathematics, which has evolved from various cultures. They are acquired through the students' experiences in society and in mathematics lessons discussions (Kacerja & Julie, 2023), which can shape their perspective towards the world. Moreover, values influence the development of other beliefs in life and towards mathematics. Researchers have pointed to a lack of research linking mathematics education to values (Bishop et al., 2003). Mathematics is perceived as a universal subject, and mathematical concepts are not related

to any specific culture or geographical location. This is one of the reasons why many people see mathematics as a "Western" discipline devoid of values and culture (Corey & Ninomiya, 2019).

In conclusion, this study discusses the importance of integrating social and cultural values into mathematics education. This is a crucial and intriguing topic that sheds light on various directions in mathematics education.

The Study

The aim of this study was to clarify and characterize the way to integrate social values into mathematics class. The study focuses on the experience of the pre-service teachers in the related academic course and from teaching the subject to school students, as well as to explore their perspectives towards the importance of this regard.

Participants

The current research study examines the process of pre-service mathematics teachers' learning regarding the integration of social values within their instructional practices. This investigation is conducted within the framework of an academic course offered at one of the Arab teacher education colleges in Israel. The course "Curriculum Planning in Mathematics", is taught by one of the authors and explicitly addresses the theme of social values education in mathematics instruction. The subject matter is taught over four weekly sessions, each of two academic hours.

The research participants were 18 pre-service mathematics teachers who studied the course. All of them are studying in the mathematics education program with a specialization in middle and high school from 7th grade to 10th grade and are from the Arab society in Israel.

Study Tools

This paper focuses on the qualitative data collected from various research tools: (1) Classroom observations in which the reactions and responses of the participants was reported by the authors; (2) pre-Course Questionnaire that solicited their views regarding the feasibility of integrating social values into mathematics class; (3) Post-Course Questionnaire that includes open-ended questions; (4) End-of-course task: the students were asked to develop mathematical problems within the context of social values; (5) Personal Reflections on the course and the experience of teaching the subject to school students.

Research Process

At the beginning of studying the topic on the integration of social values into mathematics in the course, a preliminary questionnaire was administered to assess the possibility of incorporating social values into mathematics lessons, followed by classroom discussions. The purpose was to examine how students perceive the

integration of social values into mathematics class and the extent of their exposure to the topic. Subsequently, students were asked to construct a lexicon of values starting with each letter. Each value added to the lexicon needed to be accompanied by a brief description defining it. This lexicon served as a database in the course site. After that, the pre-service mathematics teachers experienced teaching mathematics in social values context into their mathematics classes in the schools where they were practicing. Then they reported this experience.

At the end of the course, the students submitted an assignment on the subject and wrote a personal reflection on the course and their experience in school.

Findings

The findings indicated that the pre-service mathematics teachers went through a learning process to be able to teach the subject in schools. The process is presented below from the beginning of the course when the pre-service mathematics teachers were lack of knowledge about the connection between mathematics and social values. Then the mathematics content that they studied in the course will be presented and their experience when teaching mathematics with integrating social values and discussions with their students in schools. *Teaching Mathematics that Incorporates Social Values* which is presented below answer the main question of this research about the way social values can be integrated in mathematics class.

Lack of Knowledge

The findings of the current study indicated that at the beginning of the course the pre-service teachers were lack of knowledge about possibility of teaching social values in mathematics class. They were not aware to the subject. The observations, discussions, and the pre-course questionnaire indicated that the pre-service mathematics teachers approached social values in a general manner, detached from mathematical content, and they displayed a limited understanding of the subject matter. Although they acknowledged the importance of the subject, their responses remained generalized and suggested a minimal distinction in their perceptions between teaching social values in a mathematics lesson and in any other class, including subjects outside mathematics. For instance, the students expressed: *"I never thought that we can integrate social values in mathematics class", or "I noticed that textbooks in mathematics don't have a space for social values"*.

Introducing to the Subject

From the discussions at the beginning of the course the students introduced to the pivotal theme of social values. Examples were given by the lecturer about mathematical concepts like "similarity", a concept with which pre-service teachers were already acquainted through their prior understanding of triangle similarity. Subsequently, they engaged in a discourse exploring the connotations of this mathematical concept and the social values associated with it. Among these social values was the notion of "acceptance of the other", a value inculcated in the pre-service teachers during their earlier education as part of social skills lessons. The social value "the other is me- sometimes I'm similar, and sometimes I'm different -but I'm always equal", emphasizing the recognition

that individuals may exhibit both similarities and differences, yet remain fundamentally equal. Notably, this value was instructed in the educational curriculum by the Ministry of Education in our country in 2013. Pre-service mathematics teachers had not previously applied this specific social value within their mathematics instruction. However, through a deep and extensive discussion in the course, their awareness of the potential integration of such values into the mathematics classroom was notably arose. They recognized that this connection could be explicitly conveyed through word problems in mathematics or by problems that present a situation with the connection to social values. The preservice teachers started giving examples by themselves. As part of their coursework, they were tasked with constructing a lexicon of values that encompassed the entire alphabet, requiring each value to be accompanied by a concise description elucidating its essence. This lexicon, established as a central resource within the course platform, served as a source from which students could select values. These social values served dual purposes: (1) to establish meaningful relations between social values and mathematical concepts, exemplified by the use of the letter 'e' to signify "equality," which could be conceptually associated with mathematical equations, or 'b' as "belonging", which could be linked to the concept of membership in a set; and (2) values that could be integrated into the word problems by developing mathematical situations related to the chosen value.

Teaching Mathematics that Incorporates Social Values

During the course, the pre-service teachers developed word problems incorporate social values. They utilized the lexicon which served them as a database for social values from which they could select. Then they were asked to add questions related explicitly to social values. At the end of the topic, the pre-service mathematics teachers developed instructional lessons in mathematics that included word problems with social values arising from the context of the problem or related to a mathematical concept that has a mathematical meaning as well as a value and social meaning. Then they delivered the instructional lesson to their mathematics classes at the school where they were undergoing training. They taught the subject and discussed social values with their school students. Below are presented two examples of the instructional lessons for 10th and 8th grade classes.

Below are two examples, when the first discusses social values arising from the context of the problem, while the second is related to a mathematical concept that has a mathematical meaning as well as a value and social meaning.

Example 1

An example that discusses social values arising from the context of the word problem:

In four days will be an exam in the subject of growth and decay for 10th grade classes. Each student in the 10th grade-A class has to help two other students from other classes on preparing for the exam. And the two that each was helped will also help two other students, and so on. We will check how many students were helped until the day of the exam.

- a. What is the growth rate? (the answer is: 2)
- b. On the first day, how many students received help if there are 8 students in the 10th grade-A class? (the

answer is: 16)

- c. On the second day, how many students received help? (32)
- d. Calculate how many students in total received help during the 3 days? ($16+32+64=112$)

Social values questions related to this mathematics problem that were taught by the pre-service teacher:

- ❖ What does the word "help" mean to you?
- ❖ How can "help" be translated into actions?
- ❖ Do you expect a return at the same time when helping?
- ❖ How do you feel when you help someone else?
- ❖ After you solve the mathematic problem about the number of people we could help, what is your conclusion?

The discussion with the 10th grade-A class students that the pre-service teacher reported in the end-course task, indicated that the response of the students was: "when someone help others, he will also benefit from this help". They understood the extent of the impact of "help" and realized this value in their lives; "helping others can give someone a satisfaction".

Example 2

An example that discusses social values related to a mathematical concept that has a mathematical meaning as well as a value and social meaning. The concept "inequality" in math is a common concept that is studied in 8th grade. One pre-service teacher chose to teach the subject out of its importance and in order to raise the awareness of the students toward the issue, as she pointed out in her written reflection. She also had a discussion with her students about equality as a social value and about the concept of inequality in everyday life. In the discussion, she addressed questions such as:

- ❖ What is the meaning of the "inequality" as mathematical concept?
- ❖ What can you say about such a concept socially?
- ❖ Can you share about your experience related to this concept?
- ❖ Has there ever been a case where you felt unequal?
- ❖ Why is it sometimes difficult to be equal between people?
- ❖ What do you think about the value of equality?
- ❖ Are there things we are all equal in?
- ❖ What can you do to have equality between your friends?
- ❖ Do you support equality in everything?

The school students were very active in the class as the pre-service teacher mentioned. In the discussion the feedback of the students was that "equality always means justice, and in my opinion, it boils down to problems and comparisons, so when each person takes the same as the other, he will be satisfied". Othe student gave a

different interpretation for the concept as: "In my opinion, the difference is a beautiful thing, it adds a taste for life".

Reflections on the Course and the Teaching Experience

Reflections of the pre-service teachers on the course pointed that it was interesting and inspiring, as they noticed: "The course was interesting and fascinating, and this will be true for my future students as well. Understanding the importance of integrating social values into mathematics education is inspiring and significant."

They also stated that from the discussions in the course they learned by themselves some social values, as one student inscribed:

We learned to be caring, concerned, and tolerant. values are an integral part of every lesson that we can indeed make students feel a sense of belonging. Thus, we will achieve even a small measure of their success. It was an interesting course because values are important in our lives.

They pointed about inquiring content and pedagogical knowledge about the subject:

The course provided us with a different perspective on mathematics lesson planning. We learned how to integrate and apply the social values topic into the lesson, connecting values with the curriculum because teaching mathematics also involves values education, which is essential for achieving educational goals after every lesson.

Another student stated:

Through the assignment, we learned the significance of values and managed to pose mathematical word problems that enabled us to have social discussions in class, even if it was our first experience. it was the first time in my lesson planning that I consider such topic and how I could teach a lesson with values.

The content knowledge acquired by the students is evident primarily in the development of two main types of mathematical word problems: (1) Problems that incorporate social values related to situations in mathematical problems explicitly or through a context that allows for social values discussions. (2) Social values intertwined with mathematical content. These values are abstracted from mathematical concepts and exhibit a societal connection.

The reflections of the pre-service mathematics teachers on their experience revealed that teaching mathematics within a context of social values was not only engaging but also intriguing for them. The post-course questionnaires indicated that the pre-service teachers benefited from this experience. They realize now the importance of integrating social values in mathematics class: "Within the mathematics lesson, it is essential to focus on cultivating social values to foster progress and development in society". They pointed to the additional

value of creating a productive discussion with school students: "I'm glad that I managed to develop word problems that help me create discussions with school students on social values and their importance. The integration of values into math lessons can be significant and commendable". And that gives the mathematics lesson a meaning and role in our life:

Values are an integral part of our lives. Integrating values into math lessons can give students a sense of belonging and enhance their understanding that mathematics is not just a technical tool but also a practical for understanding and interpreting the world.

They pointed out to their experience in teaching the subject as an attractive and that discussing social values in mathematics class helps in understanding the way the students think. As they described it like giving "humanity" to a lesson:

It is a fascinating experience, almost like giving the lesson a more human touch. The combination between the mathematics and social values exposes students' thought processes, allowing math teachers to present the study material in a manner that aligns with their thinking patterns.

Discussion

This study, aligning with the recommendations of educators, aimed to investigate the process of integrating social values into the mathematics classroom (Mamolo, 2018). The participants consisted of pre-service mathematics teachers from the Arab sector in Israel who were enrolled in a mathematics course that incorporated social values at an Arab college for education. The study's findings, derived through a triangulation of qualitative data from various research tools, including course observations, open-ended feedback responses, written reflections, and summative assignments, indicated a significant and enriching learning experience for the pre-service mathematics teachers in terms of integrating social values into mathematics instruction. Throughout the course, the participants acquired insights into how to integrate social values into mathematical content. They actively engaged in classroom discussions on these values and applied them in their mathematics lessons as an integral part of the mathematical curriculum. This educational experience presented a challenging task for the pre-service teachers, demanding additional effort in the preparation of instructional materials for their classes (Bartell, 2013). In accordance with the work of researchers like Bishop (2008) and Ernest (2012), the findings underscored a deepening of the participants' understanding of the significance of integrating social values into mathematics lessons, along with an enhancement of their attitudes toward this subject. At the beginning of the course, there existed a general lack of awareness among the participants regarding the nature of social values and their connection to mathematical content.

However, as the course progressed and the participants began actively teaching the subject, their comprehension of the relationship between values and mathematics deepened. The findings indicated an enriched knowledge base across different dimensions, including content knowledge and pedagogical content knowledge. The participants perceived the integration of social values into mathematics instruction as a challenging undertaking that demanded

additional effort from them (Bartell, 2013). As they themselves reported, the course equipped them with the skills and strategies needed to effectively incorporate values into mathematics lessons, fostering discussions on this topic in their classrooms. Additionally, they acquired content knowledge that manifested primarily in the development of two main types of mathematical word problems: (a) Problems that explicitly integrated social values related to situations in mathematical word problems or through a context conducive to social discussions; (b) Problems in which social values were intertwined with mathematical content, abstracted from mathematical concepts and with a clear social connection.

This study highlights the importance of values-oriented education in the training of teachers and the professional development processes of educators. In line with Vinner (2009), it emphasizes the need for teachers to possess awareness and the capacity to address social values effectively in the educational context.

Conclusion

This study investigates the education of pre-service mathematics teachers and their journey towards integrating social values into their teaching practices. Initially, these pre-service teachers lacked awareness of the potential for merging social values with mathematics education. They viewed social values as separate from mathematical content. However, as they progressed in their training, they were introduced to the concept of integrating social values into mathematics, leading to a deeper understanding of this connection. Through instructional lessons that included such problems, they engaged students in discussions about these values and their significance, enhancing comprehension of the link between mathematics and real-life social contexts.

The study highlights that incorporating social values into mathematics not only enriches the subject but also promotes critical thinking and discussions about the broader social context in which mathematics operates. In conclusion, this research sheds light on the education process of pre-service mathematics teachers as they evolve from a lack of initial awareness to a deeper understanding of the significance of teaching mathematics with integrated social values. By fostering a connection between mathematics and social values, teachers can engage students in more meaningful learning experiences and encourage them to think critically about the social implications of mathematical concepts. These findings highlight the potential to enhance mathematics education by infusing it with values that contribute to students' personal and social development.

Recommendations

In further research, it is advisable to investigate the perspectives held by in-service mathematics teachers regarding the integration of social values within the mathematics curriculum. This examination should explore whether these teachers actively prioritize the incorporation of such values within their instructional practices. In a broader, comprehensive study, there arises an opportunity to develop an intervention program designed to embed social values into the mathematical content delivered over an extended duration. Additionally, this study should include an assessment of the attitudes and responses of school students towards the incorporation of social values within the mathematics class.

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