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THE BOSNIA AND HERZEGOVINA PROSPECTIVE PRE-SCHOOL TEACHERS' REFLECTION ABOUT THEIR UNIVERSITY MATHEMATICAL EDUCATION

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Abstract. In this article, we collected reflections on the course 'Elementary Mathematical Concepts' from the study group for the pre-school teacher education. Through systematizing information obtained by testing 62 students of this study group, the author, although acknowledging that the unreliability of the data collected is very high, nevertheless presents to the academic community his own thoughts about the peculiarities of the mathematical education of this population of students in the Republic of Srpska (an entity of Bosnia and Herzegovina). Of course, the social political community has significantly greater impact on the quality of mathematics teacher education than university staff. The author is convinced that this and similar research texts are an important indicator of the impact of the background deep power on the quality of mathematical education of pre-school teachers in our educational system.

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INTRODUCTION

Beliefs play a major role in acquiring mathematical proficiencies during school and university education. Learning and understanding of cognitively demanding mathematical concepts and processes are strongly related to schoolchildren / university students' beliefs about mathematics [12]. These beliefs are developed or acquired during school and university education.

During the past thirty years, the number of research studies on school students', university students' and their teachers' attitude and beliefs about mathematics and mathematics education is significantly present in many countries. In these studies the academic society is looking for answers to several different questions. For example, Kloosterman [19] wondered: 'What do students think about mathematics?'; Pehkonen and Törner [32] explored the answers to the questions: 'What information from different sources and which tools from these sources can be used to investigate the beliefs on mathematics teachers?' and 'Which of the methods are optimal for different aspects of such research?'

Our problem is the following:

The author of this text was several years a tutor of the course 'Elementary Mathematical Concepts' [EMC] at the study group for the education of preschool teachers at two educational faculties in Bosnia and Herzegovina [B&H]: at the Bijeljina faculty of education (The Republic of Srpska – [RS]) and at Bihać faculty of education (The Federation of Bosnia and Herzegovina – [FB&H]). It is a compulsory course and consisted of the following topics: 1. Introduction to mathematical logic; 2. Naive set theory; 3. Sets of numbers (natural, integral and rational); 4. Introduction to Euclidean geometry. This course allows students to enrich their logical and mathematical vocabulary. The course is designed to allow students to understand, accept, and use elementary logical functions and several fundamental logical conclusion rules. A sufficient number of hours are planned for understanding and accepting the interaction between sets. A distinction is made between the concepts of relations, operations, and functions. In negotiating with students about the properties of the set of natural numbers, the properties of the equality, addition and multiplication of natural numbers are pointed out. In the section dealing with elementary geometry, students were in a position to recapitulate their memories of Euclidean geometry learned in the secondary school.

In our environment, it is customary that candidates with extremely modest mathematical skills enroll in this study group program. The usual practice in our educational system for many years is that the criteria for evaluating mathematical knowledge and the skills of these students are very low. This author is deeply convinced that the successful completion of high school education of these candidates is questionable. Also, it is widely believed that such candidates have hardly developed the ability to listen, understand and follow mathematical content at the academic level of education. Unfortunately, there are no other students in B&H except those. The problems are:

1. Should the gap between the information officially reported by the social and academic community, on the one hand, and the realistic status, on the other hand, be noted in relation to the mentioned phenomena?

2. How can one find the parameters by which, in a socially acceptable and socio-politically correct manner, it is possible to speak of recognizable phenomena?

The author also accepts the opinion of the academic community that the importance of mathematics for general and special education of the implementers of activities in any pre-school institutions identifiabled and generally accepted.

The pre-school system in our educational system, judging by a non small number of indicators, in most cases implies preservation and care of children of pre-school age. In expressing this attitude, we mean an underdeveloped and completely neglected system of activities that should introduce participants to a number of mathematical concepts, their interrelations, as well as a large number of socio-mathematical norms that are naturally related to previous activities. A significant part of the responsibility for this situation in our pre-school system is in the jurisdiction of the social community and its public institutions. Although the area of responsibility of the implementers of activities in the pre-school system is very small (in our opinion, it does not exceed 5%), it should not be ignored. Even in such a small area of responsibility, implementers of activities in preschool institutions have enough space to support the development of children's abilities in recognizing, understanding, accepting and using a great number of mathematical concepts and their interrelations with their quality education and work in accordance with the programs of that system. Apart from the point, they can significantly influence their students to accept as their own some of the socio-mathematical norms related to the chosen concepts and processes with them. Of course, implementers of activities in pre-school institutions understand that some of their beliefs about the importance of mathematical thinking and some of their established attitudes about mathematical concepts and processes with them constantly introduced to the students of preschool institutions, putting them in a position what they have to face a significant number of beliefs.

Education of implementers of activities in preschool institutions in the RS is a burden with a number of negligence. Linguistic, mathematical and didactical education of prospective teachers in pre-school institutions is extremely low quality, in my opinion. Students with the lowest qualifications are enrolled in this study group. Generally speaking, the orientation of the social community through the continuous pressure of the university administration manifests itself with the instructions that student success in this study group does not have to be registered to be considered satisfactory.

What do we want to achieve?

First, we intend to register the situation in the mathematical education of future implementers of mathematical activities in pre-school institutions in our society. We deeply believe that the socio-political reality in RS will be significantly changed in the near future. We believe that new policy makers will appear who would devote much more attention and funding to teacher education than it is now. We believe that this report can serve as a benchmark for comparison with the orientation in the education of the new social community.

Desirable mathematical competences of prospective preschool's teachers

The world in which we now live is going fast through significant changes. The plethora of new information surrounding new generations and a significant number of new information tools through which this information reaches them imply that 'being mathematically skilled' is of high importance. By accepting such assessment, those who understand mathematics and have the ability to think mathematically have more possibilities and more opportunities for shaping their future. Therefore, building mathematical knowledge and developing mathematical abilities is considered one of the key strategies for the generations to come to be creative and innovative [27]. The unsatisfactory mathematical literacy, we estimate, significantly influences and will affect the insufficient understanding of future technologies that will surround us. The mediocrity in mathematics and related science is considered one of the greatest imperfections of future generations in their competitiveness in the time to come. Without significant and constant adaptation of mathematical education to contemporary trends, our future generations will not be able to even approach the success of the nations that give that education much more attention than we do. It is completely irrational to be convinced in our ability to be successful in anything like advanced nations whose policy makers devote significantly more attention and funds to mathematical education. Therefore, we estimate, mathematics and mathematics education should be more strongly present in the focus of this social community.

Generally speaking, each member of any population has the capacity to be enough mathematical literate. Consolidation and raising mathematical proficiencies of people should be an obligation of our academic community. It is estimated that the differences between mathematically successful nations and those of others begin in pre-school institutions ([13], [10]). In order to develop the necessary mathematical skills of proteges in the pre-school institutions, it is necessary that these institutions have mathematically and didactically competent implementers of activities.

Research shows (see: [1], [12], [15], [28], [33], [34], [39]) that more competent implementers of mathematical contents in pre-school institutions have a significantly stronger impact on the achievements of their students compared to those who are poorer with the necessary mathematical, linguistic and appropriate didactic competencies. Competent implementers of mathematical content in pre-school institutions should have a deep understanding of these mathematical contents, but also an understanding of the process of teaching and learning of pre-school students. It should be emphasized here that the necessary mathematical knowledge and the necessary methodical knowledge for the needs of these institutions are very specific and significantly differ from the mathematical skills in other professions. Shulman [44] emphasized that teachers in pre-school institutions should have significant didactical and psychological knowledge of mathematical content in order to be the best supporter of students in those institutions. This includes the ability to understand the contents of mathematics and the ability to teach to students of different levels of maturity in pre-school institutions.

Linking this text with analogue research

The research of mathematical ([4], [5], [6], [7], [8], [9], [10], [13], [14], [15], [23], [27], [28], [40], [44]) and methodological-didactic (mathematical-methodical and methodological-mathematical) ([22], [24], [26], [33], [34], [39] and [46]) competences of future implementers of activities in pre-school institutions is strongly present in the international academic community of researchers of mathematical education. Teacher beliefs and attitudes about mathematics and mathematical observation are often investigated ([1], [2], [3], [11], [15], [16], [17], [18], [20], [21, [25], [30], [41], [42], [43], [45], [47], [48] and [49]).

Many of these studies have only an academic character. We do not think that we are engaged in changing the situation.

With this text we complement our research of teacher education mathematics for all levels in the school system in the Republic of Srpska, which we started with our earlier papers [35], [36], [37] and [38]. At the same time, the material presented in this paper is the expansion and deepening of our recently published text [31].

METODOLOGY

Participants

62 students of the study group program for academic education of preschool institutions at two pedagogical faculties in BiH took part in the study.

Instruments

All participants filled in the rankings for examining attitudes and beliefs conceived by the author of this text. In addition to this scale, students also reported the type of secondary school that they had previously completed and the average grades in mathematics in previous education. An individual interview was conducted with each of the tested candidates. In these interviews each candidate was given the opportunity to explain more precisely the answers they offered during this testing.

Table 1

1. Do you know what is the syllabus of the EMC course?
2. Do you know the topic titles in the EMC syllabus?
3. Write at least three topics in the EMC syllabus
4. What did you expect from the EMC course?
5. Have you regularly attended lectures?
6. Do you think the EMC course is necessary for your academic education?
7. Did the implementation of the EMC course affect you?
8. Could you understand the mathematical language used by the professor and his assistants?
9. What do you think should be changed and why in implementing the EMC course?

In the first hours, the teacher and assistants introduce their listeners with the elements of the syllabus (the curriculum / plan of teaching - the number of lessons and the number of exercises per week and during the course of a single semester, the curriculum \ program - Course objectives, thematic contents, student commitments, the way of student performance evaluation). It is quite natural to ask the question: What do we want to achieve with these issues? Questions 1, 2, and 3 make one whole. Obviously, the first question is a rhetorical question. It was expected that the vast majority of tested students affirmatively answered this question. In order to confirm the previous statement, students were expected to offer precise topic titles of the previously completed course, in response to question 2 and question 3.

We will look at questions 4 and 6 as one single question. In analyzing students' reflections on these questions we will offer our thoughts as interpretations of the phenomena that cover these two questions. Since in our university education we do not request from the listeners to attend lectures and trainings, students rarely fulfill their obligations. Question 5 refers to this phenomenon. The remaining questions are individual units.

The last question is the usual question. In this kind of student reflection study at the end of the course, this question is almost a rhetorical question. The examiner does not expect students to be able to assess the design quality of the course. Students were expected to know and understand the difference between the term 'teaching plan' and the term 'teaching program'.

This researcher of mathematical education of implementers of mathematical content in pre-school institutions is inclined to generalize the view that the quality of mathematical and mathematical-methodical education of prospective teachers in these institutions is inadmissibly low. With this commitment, the intention of this paper is to be another argument in encouraging and justifying the opening of the dialogue

between the academic society and the social community in our educational system about a stronger increase in the quality of mathematical education of future pre-school teachers.

RESULTS AND ANALYSIS

A. Input data

In order to gain insight into the level and quality of the mathematical examination of the tested candidates, we put before the reader the data representing their previous education. It is generally accepted that in our high school system mathematical education is high enough in gymnasiums and secondary technical schools since it is practicing mathematics in all four years of that system. We added to this group for other reasons candidates who completed secondary medical school. For these candidates, we believe that they are highly motivated to successfully complete this study. The remaining schools that appear in Table 1 or do not have mathematics (e.g., secondary music school) or have mathematics for only first two years (e.g., secondary agricultural and economics schools).

type of secondary school	no data	secondary agricultural school	secondary school of economics.	secondary music school	medical secondary School	gymnasium	technical High school	**Σ**
	6	4	24	2	4	16	6	**62**
%	9.68	6.45	38.71	3.23	6.45	25.08	9.68	**100.0**
	58.06				**41.94**			

Table 1. Distribution of tested candidates according to finished secondary school.

The six candidates did not indicate which school they finished.. Colloquially speeking, we are inclined to accept the orientation that these candidates did not successfully complete the high school at all, but the certificate of completion of the school was obtained in a non-standard way. The indicators in Table 1 suggest that only 42% of the tested candidates are formally trained to participate in the academic process at the university.

In order to gain a deeper insight into the mathematical literacy of candidates, they were asked to present grades of their success in secondary school mathematics. In our school system, the maximum value of success is number 5.

Average grade	No data	2	2.5	3	3.5	4	4.5	**Σ**
Numbers of candidates	13	15	8	18	4	2	2	**62**
%	20.97	24.19	12.9	29.03	6.45	3.23	6.45	
	58.07			**41.93**				

Table 2. The distribution of the average grade for the success of tested student in mathematics.

Mathematical literacy of 58% of the tested candidates was evaluated with less than a 3 grade of average. 16 or 21% of the candidates did not provide their grades in secondary school mathematics. Of the 62 tested candidates, only 12.9% have an average grade of greater than 3. The readers of this text should accept as valid the following information: an assessment of less than 3 grade average is actually an insufficient grade in our school system since it is a common practice supported by the academic and social community to estimate students with sufficient higher grades even if they do not deserve it.

B. Output data / Questions

1. Do you know what is the syllabus of the EMC course?

The answers of the tested students to the first question are shown in the following table:

	YES	NO	Partly	No answer	**Σ**
	8	44	4	6	**62**
%	12.9	70.97	6.45	9.68	

Table 3. Distribution of student responses to the first question.

Note that regardless of the fact that the first question was a rhetorical and, 50 (= 44 + 6) students stated that they did not know what the syllabus of the EMC course looks like. This indicator raises many questions. Let's leave the question 'How is it possible?' unanswered since the teacher and his assistants are required to introduce students to the elements of the syllabus at the beginning of the course. In addition, full information on the course is available on the Faculty website. It seems to us that an acceptable explanation to the above question is negligence students brought with them from high school. Since the syllabus contains a list of compulsory literature, it can be assumed that a significant number of the tested students are not prepared for classes; they do not participate actively in lectures and exercises and do not fill up their knowledge with new content.

2. Do you know the topic titles in the EMC syllabus?

The reflections of the tested students about the second question are presented in the following table:

	YES	NO	Partly	No answer	**Σ**
	22	34	2	4	**62**
%	35.48	54.84	3.23	6.45	

Table 4. Distribution of student responses to the second question.

3. Write at least three topics in the EMC syllabus

Below are presented the reflections of the tested students about the Third question:

Topic 1: *Introduction to mathematical logic* - 51
(Introduction to mathematical logic – 5, Logic - 14, Logical statements - 2, Propositional calculus - 2, What is mathematical logic? - 4, Mathematical logic - 9, Predicative calculus - 2, Logical mathematics - 13)

Topic 2: *Naïve set theory* - 57
(Naïve set theory – 15, Relations, Functions and Sets – 5, Sets – 12, What is set theory? – 5, Functions – 9, Mutual relations of sets – 3, Relations and Functions – 3, Relations, Functions and Operations – 3, Relations – 1, Sets with relations – 1)

Topic 3: *Number sets* - 11
(Number sets – 7, Numbers – 3, Even numbers – 1)

Topic 4: *Introduction to Euclidean geometry* - 15
(Geometry – 11, Elemental geometry – 3, Non-Euclidean Geometry – 1)

Comments on reflections on second and third questions:
22 students answered that they know the titles of the topics of this course. This proved to be unreliable information because, in the question 3, they were asked to indicate the exact names of at least three themes. 51 out of 62 students offered their belief on topic title 1: Introduction to mathematical logic. Only 5 of them managed to write the exact title of this topic. Although 57 test students wrote that they know the title of topic 2, the reality is significantly more unreliable: 15 of them knew the exact title. It is very disturbing that only 7 students have written the correct title of topic 3: Sets of numbers. It is surprising that no student has written the correct title of topic 4.

How do we comment on this data? First, there is a significant gap between students' beliefs about their mathematical literacy, on the one hand, and their really mastered mathematical proficiencies, on the other hand. Second, student mathematical vocabulary is not reliable. This particularly refers to the understanding, acceptance and using of a small number of mathematical notions.

4. What did you expect from the EMC course?

4.1. To raise the level of my mathematical knowledge;
4.2. To learn something new in mathematics;
4.3. Nothing;
4.4. I cannot decide;
4.5. No answer.

Student answers to the fourth question are presented in Table 5.

Question	4.1.	4.2.	4.3.	4.4.	4.4.	**Σ**
	28	24	8	1	1	**62**
%	45.16	38.71	12.9	1.61	1.61	

Table 5. Distribution of student responses to the fourth question.

Note that by designing the fourth question, our intention was to gain insight into the attitude students have regarding the mathematical content of this course. During the realization of the EMC course, it was specially insisted on perceiving and distinguishing the description of mathematical concepts processes from their precise mathematical definitions. The problem of evaluating students' responses to this question is related to the fact that this testing was done before their final testing. Analyzing students' reflections on this issue we estimate that it is a population of persons who are intellectually capable of understanding, accepting and using in their future work cognitively demanding mathematical content. When asked, 'Why are their abilities not developed more forcefully?' the answer is most likely to be sought to the orientation of the social and academic communities on their mathematics education in elementary and secondary schools.

5. Have you regularly attended lectures?

5.1. Yes
5.2. Sometimes / Often
5.3. Sometimes / Rarely
5.4. No
5.5. No answer

Student choices regarding the fifth question are presented in the table in Table 6.

	5.1.	5.2.	5.3.	5.4.	5.5.	Σ
	47	6	5	2	2	**62**
%	75.81	9.68	8.06	3.23	3.23	

Table 6. Distribution of student responses to the fifth question.

It should be noted that our interest in students' answers to this question has meaning only in our educational system since it is accepted that the students are not obliged to attend classes. It is an unwritten agreement among the policy maker, the university administration and the students. In our community, it is not a rare occurrence that student associations perform extra-institutional affairs of the striking power for the so-called deep policy-makers. Of course, students' statements about their regular participation in classes should be accepted with the utmost restraint. If the teacher or assistant refuses to confirm their attendance, the signature of the faculty dean or the signature of one of the members of the rector's cabinet can compensate the teacher's signature.

6. Do you think the EMC course is necessary for your academic education?

6.1. Yes
6.2. No
6.3. I do not know
6.4. No answer

Student's answers to the sixth question are shown in Table 7.

	6.1.	6.2.	6.3.	6.4.	Σ
	16	10	32	4	62
%	25.81	16.13	51.61	6.45	

Table 7. Distribution of student responses to the sixth question.

7. Did the implementation of the EMC course affect you?

The following options are offered in response to this question:

7.1. Yes, I am satisfied with the organization of classes.
7.2. I am partially satisfied with the organization of teaching (more yes than not).
7.3. I am partially satisfied with the organization of classes (no more than yes).
7.4. I am not satisfied with the organization of classes.
7.5. No answer

In Table 8, student answers to the seventh question are exposed.

Question	7.1.	7.2.	7.3.	7.4.	7.5.	Σ
	12	24	23	0	3	62
%	19.35	38.71	37.01	0.0	4.84	

Table 8. Distribution of student responses to seventh question.

8. **Could you understand the mathematical language used by the professor and his assistants**?

In response to this question, students could choose one of the following possibilities:

8.1. Yes
8.2. Partially (more yes than no)
8.3. Partially (more no than yes).
8.4. I am not / Rarely
8.5. No answer

The following table shows student answers to this question.

Question	8.1.	8.2.	8.3.	8.3.	8.4.	Σ
	12	19	16	9	6	62
%	19.35	30.65	25.81	14.51	9.68	

Table 9. Distribution of student responses to the ninth question.

Comments about students' reflection on question 7 and 8:

Half of the tested students answered that they are not familiar with the academic language used by the teacher and assistants in the realization of this course. This reinforces the belief of this researcher that the mathematical vocabulary of the tested students is underdeveloped to follow, understand and accept the knowledge that should be acquired through teaching. The natural question immediately arises: 'How can students evaluate what to offer in response to question 7?' How can 58% of students be satisfied with the organization and realization of the EMC course without being sure which mathematical ideas they should pay attention to. In particular, 'What principled-philosophical approaches to understanding mathematical concepts and processes with them need to be understood and adopted?

9. What do you think should change and why in implementing the EMC course?

9.1. Teaching plan
9.2. Teaching program
9.3. Operationalization of the teaching process

9.4. Nothing
9.5. No answer

The distribution of student responses to the last question is shown in Table 10.

Question	9.1.	9.2.	9.3.	9.4.	9.5	**Σ**
	4	17	31	3	7	62
%	6.45	27.42	50.0	4.84	11.29	

Table 10. Distribution of student responses to the ninth question.

This researcher is convinced that the vast majorities of the tested students not only do not know the elements of the syllabus but have not developed the ability to view the internal organization and the integrity of the EMC course. By accepting this belief as an orientation in the deduction of the conclusions from the feedback received in this study, the general impression should be the complete unreliability of the data collected.

CONCLUSIONS

In order to gain insight into beliefs of pre-service kindergarten / pre-school teacher's about mathematics education, we conducted interviews with students on several faculties in B&H. The notion of 'pre-schools teacher' means kindergarten teacher in our school system.

According to what we explored within two B&H faculty of education, in the sample of our sixty-two students, who are preparing to be teachers in preschools in RS and the FB&H, we concluded the following:

- The course *Elementary mathematical concepts* (EMC), what is taught and learned in the first year, is very useful and necessary for these students since they entered this college with very poor math skills. In particular, their mathematical vocabulary is very poor.
- Almost 65% of tested students possess insufficient knowledge of high school mathematics. 87% of them have a very low average grade in this subject. We estimate that it is very difficult for them to follow lectures of the academic course EMC.
- Their beliefs about the importance of mathematics and necessity of mathematics education for the future profession are questionable, i.e., low and insufficient, and their motivation for the course EMC are extremely poor.
- These researchers believe that these parameters in our university education of this teacher's profile cannot significantly change in the short term.

We believe that this situation can not be changed much in the short term, regardless of the fact that the current results are devastating. Therefore, we suggest to the those in academia who are researching the system of pre-school education to devote due attention to the necessary mathematical knowledge and necessary methodical knowledge of the implementers of mathematical contents in pre-school institutions, and to publish the observations and thoughts about the collected data. We are inclined to believe that an increasing number of such research would be an incentive for the social community to provide a much better quality of this kind of education.

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