

## A VIEW ON RESEARCH IN MATHEMATICS EDUCATION IN REPUBLIC OF SRPSKA DURING 2010–2015 THROUGH QUANTITATIVE ANALYSIS OF PUBLISHED TEXTS

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**Abstract.** Studies of the publishing practices in mathematics education have situated sets of journals in tiers of quality. These reports document the rankings and prestige of only a subset of the wealth of journals available for publishing in mathematics education. We posit that there is value, quality, and purpose to be found in journals that present studies that are of value on a regional level, and that the studies are extremely important to the field. This is particularly important for journals published in languages other than English, and the studies referenced above are almost entirely English-language journals. In this paper we seek to demonstrate that we as a field of researchers cannot discount the value and role of these regional and small-country journals. Using a case study of one small European country, we quantitatively present the areas of strength and weakness in the publishing practices in mathematics education journals that are unlikely to be seen beyond the region of their publication. We conclude with recommendations to publish in areas where research is lacking as well as recommendations to the community at large to recognize the value of such outlets.

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*MSC Subject Classification:* 97A30

*Key words and phrases:* Academic journals; Publication analysis; Publishing; Researchers; Scientific journals

### 1. Introduction

Studies of the publishing practices in mathematics education have situated sets of journals in tiers of quality [19]. These reports document the rankings and prestige of only a subset of the wealth of journals available for publishing in mathematics education, although they do acknowledge there are regional journals that serve purposes beyond the scope of their rankings. In this paper we seek to demonstrate that we as a field of researchers cannot discount the value and role of these regional and small-country journals. Taking the findings of studies that rank journals into Tiers 1, 2, and 3 would by default mean that all the others not listed are less than a Tier 3 journal. However, we take issue with this implication, and seek to demonstrate that there is value, quality, and purpose to be found in journals that present studies that may be of value on a regional level, and that the studies are extremely important to the field. This is particularly important for journals published in languages other than English, and the studies referenced above are almost entirely English-language journals.

Our research question is then: what is the value of the non-ranked, typically non-English speaking journals in the field of mathematics education.

To answer this question, we use a case study methodology [33], using one small European country, the Republic of Srpska [RS], as our unit of analysis. The RS was chosen because the social and political aspects related to mathematical education in the region are strongly expressed due to poverty, it being a very small political community, and no mathematics education journals from the RS have been indexed in the Scopus database [18]. The operationalization of teaching mathematics in the school system presents room for growth in professional development since the teaching, in most cases, is implemented in a traditional format [4]. Interestingly, in the mathematics education research within the RS there are no studies to confirm the success of traditional or reform-styles of teaching and learning. The current measure for success in the process of teaching and learning of mathematics in the RS school system are entrance exams at universities which has been reported in [31].

In this case study, we begin with an introduction to the mathematics education community, the structure of the public school system, and the teacher preparation structure at the universities. Then we begin a careful study of the publication efforts within the RS by answering five research questions that offer a quantitative survey of published texts by authors in mathematics education within the RS. At the end of this analysis we will present our own impressions that we have gained by reading the majority of published articles about the current state of mathematics education research in the RS. Following the case study, we conclude with a discussion on the value and merit of publishing in journals that are not necessarily ranked in the surveys of leading scholars in mathematics education.

## 2. The case of the Republic of Srpska

### Introduction

During the years 2008–2015, the Scientific Society of Mathematicians Banja Luka has informed the academic and social public about the published articles on teaching mathematics and research in mathematics education, initially written only by authors at the Banja Luka University [26–28]. In collecting and analyzing data about the published texts, from the year 2011 and on, publications by mathematicians and researchers in mathematics education have expanded beyond a group called the Scientific Society of Mathematicians Banja Luka to include authors from the entire RS, an entity of Bosnia and Herzegovina [B&H] (see, for example [17, 28]). While the increase in representation of authors has expanded, careful analysis of these studies reveal gaps in the research topics in mathematics education. For this reason we collected and analyzed published articles in the field of mathematics education research in the period 2010–2015. This paper presents the efforts of the relatively small number of authors in the RS for consideration and reflection of the problems in mathematical education from this small country, with the intention of identifying the areas for productive work to guide other similar communities in their future research in mathematics education.

### Structure of the Republic of Srpska school system

After the civilian war 1991–1995, in former Yugoslavia countries, the new government in the Republic of Srpska initiated changes in the educational system. Currently it is divided into 4 levels:

- 1) Pre-school and Kindergarten education (age 3–6)
- 2) Elementary school (age 6–15)
  - a) First triad (age 6–9)
  - b) Second triad (age 9–12), and
  - c) Third triad (age 12–15)
- 3) Secondary education (age 15–19)
  - a) Classical high schools (gymnasium)
  - b) Technical high schools, and
  - c) Three-year schools for the working and service occupations
- 4) Higher education (age 19–23)

### Teacher training

In accordance with the classification of the three school grades, three kinds of teachers' training institutions exist in the Republic of Srpska:

I. *Teacher Training Faculties for primary schools.* These institutes train teachers for the lower elementary level (grades 1–5) and takes 4 years. Their mathematical education consists of two, one-semester courses composed of 30 hours in lecture + 30 hours in exercises. Their education in teaching mathematics consists of two one-semester courses composed of 45 hours in lecture + 45 hours in exercises. There are three institutions for the education of teachers in the RS, with one of them providing two distinct pathways. Those are:

- a) Teacher Education Department at Faculty of Philosophy, University of Banja Luka;
- b) Teacher Education Department at Faculty of Philosophy, University of East Sarajevo;
- c) Teacher Education Department at the Faculty of Education at Bijeljina, University of East Sarajevo, and
- d) Teacher Education Department at the Faculty of Education, the Independent University of Banja Luka.

II. *Math Teacher Training Faculty for intermediate level*, i.e. for the upper elementary teachers (grades 6–9.) The training takes 3 years. Their training in teaching mathematics consists of a single one-semester course composed of 30 hours in lecture + 30 hours in field experience. There is only one such program in the RS, held within the Department of Mathematics at the University of Banja Luka.

III. *Universities.* Training math teachers for the secondary level (grades 10–13). The training period is 4 years. There are two such programs in the Republic of Srpska. One is at the Department of Mathematics, University of Banja Luka, and

the other is in the Department of Mathematics Faculty of Philosophy, University of East Sarajevo. Their training in teaching mathematics consists of a single one-semester course composed of 30 hours in lectures + 30 hours in exercises. The Course Program to become a high school math teacher is exactly the same as the program for teaching mathematics for middle school mathematics teachers.

### Related literature

Many communities of mathematics education research deal with the analysis of their contribution to the domains of ‘Theory of mathematics educations’ and ‘Research in mathematics education’ (for example [2, 3, 5, 14, 15, 32]). We are of the understanding that such an analysis of published articles in these domains strongly encourages both mathematicians and mathematics teachers to have studious interests in this scientific field, and we are trying to accomplish a similar purpose in the RS. This text is a continuation of our efforts [11, 17, 26–28] in that direction, and we focus on looking for answers to the following questions:

1. What is the yearly distribution of published articles?
2. What is the distribution of published texts in relation to the audience of publication?
3. What is the distribution of published articles to the media publishing?
4. What is the distribution of published texts to affiliations of authors?
5. What articles are published concerning the various levels of schooling?

### Methodology of data collection

After the end of each year the editorial board of Matematički Kolokvijum [*MAT-KOL (Banja Luka)*] has reported information on the published mathematical texts by authors of the University of Banja Luka for the previous year [27, 28]. This collection of data expands our own understanding and the other authors of the RS [17, 28]. In cataloging these activities we saw the activities of authors from other countries that had previously done similar activities [2, 3, 5, 10, 14, 15, 29, 32]. We reviewed 110 articles written by 146 authors and published in 17 different journals and several conference proceedings of different conferences. Only three of them (*IMVI OMEN*, *Int. J. Educ. Res.*, and *Technical News*) are international journals but the others are local journals from B&H and Serbia (*Norma*, *Innovation in Teaching*, *Nastava matematike*, *Proceedings of the Teacher’s Faculty at Užice*, *Learning and Teaching*, *Proceedings of the Teacher’s Faculty at Prizren-Leposavić*).

Unfortunately, only the following journals are indexed in Mathematics Education Database (2017), an international referring base for research in mathematics education and so available to the international academic community: *IMVI Open Mathematical Education Notes* (ISSN (o): 1840-4383), *Research in Mathematics Education* (ISSN (o) 1986518X), *MAT-KOL (Banja Luka)* (ISSN (o): 1986-5228) and *Nastava matematike* (ISSN (p): 0351-4463).

We have arranged the data we collected into five tables to address the five research questions above.

**Table 1. Distribution of texts by year of publication: 2010-2015**

Year	2010	2011	2012	2013	2014	2015	$\Sigma$
Number of texts	10	17	18	23	20	22	<b>110</b>
Percentage (%)	9.09	15.45	16.36	20.91	18.18	20.0	<b>100</b>

**Table 2. Distribution of texts according to domestic/international publishing**

	International	Domestic (RS)
Number of texts	8	102
Percentage (%)	7.27	92.73

**Table 3. Distribution of texts according to media publishing**

Media / Year of publishing	2010	2011	2012	2013	2014	2015	$\Sigma$	%
<i>IMVI Open Mathematical Education Notes</i> ISSN (p) 2303-4882 ISSN (o) 1840-4383	0	1	1	1	1	2	6	5.45
<i>International Journal of Education</i> ISSN (p) 2201-6333 ISSN (o) 2201-6740	0	0	0	0	1	0	1	0.91
<i>Technical News</i> [Tehnički vjesnik] ISSN (p) 1330-3651 ISSN (o) 1848-6339	0	0	0	0	0	1	1	0.91
<i>Research in Mathematics Education</i> [IMO - Istraživanje matematičkog obrazovanja] ISSN (p) 2303-4890 ISSN (o) 1986518X	5	6	5	12	8	7	43	39.09
<i>MAT-KOL (Banja Luka)</i> ISSN (p) 0354-6969 ISSN (o) 1986-5228	2	0	3	1	1	3	10	9.09
<i>New School</i> [Нова школа (Бијељина)] ISSN (p) 1840-0922 ISSN (o) 2232-8300	0	2	1	2	1	0	6	5.45

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NORMA [НОРМА (Сомбор)] ISSN 0353-7129	0	1	2	1	1	0	5	4.55
<i>Our School</i> [Naša škola (Sarajevo)] ISSN 0547-308X	0	0	1	1	1	0	3	2.73
<i>Bijeljina Methodical Journal</i> [БМЧ - Бијељински методички часопис] ISSN 2303-5366	0	0	0	0	1	5	6	5.45
<i>Innovation in Teaching</i> [Иновације у настави (Београд)] ISSN 0352-2334	0	0	0	0	1	0	1	0.91
<i>Teaching Mathematics</i> [Настава математике (Београд)] ISSN 0351-4463	1	1	0	0	0	0	2	1.82
<i>Svarog</i> [Svarog (Бања Лука)] ISSN 1986-8588	0	1	0	0	1	0	2	1.82
<i>Proceedings of Faculty of Philosophy at Pale</i> [Radovi Filozofskog fakulteta Pale] ISSN (p) 1512-5858 ISSN (o) 2232-8343	0	1	0	0	0	0	1	0.91
<i>Papers, Journal of Humanities and Social Sciences</i> [Радови, часопис за хуманистичке и друштвене науке (Бања Лука)] ISSN 1512-505X	0	0	1	0	0	0	1	0.91
<i>Proceedings of the Teacher's Faculty at Užice</i> [Зборник радова Учитељског факултета у Ужицу] ISSN 1450-6718	0	0	1	0	0	0	1	0.91
<i>Learning and Teaching</i> [Učenje i nastava] ISSN 2466-2801	0	0	0	0	0	1	1	0.91
<i>Proceedings of the Teacher Faculty at Prizren Leposavić</i> [Zbornik radova učiteljskog fakulteta u Prizrenu Leposavić]	0	0	0	0	0	1	1	0.91

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**Table 4. Distribution of the published texts according to author's affiliation**

Institution / Publishing Language	English	Serbian	$\Sigma$	%
<b>A. Banja Luka University</b>			29	19.86
A.1. Department of Mathematics and Informatics	0	0	0	0
A.2. Teacher's Education Department	0	3	3	2.05
A.3. Faculty of Civil Engineering	4	7	11	7.53
A.4. Faculty of Economy	1	3	4	2.05
A.5. Faculty of Technology	0	1	1	0.68
A.6. Faculty of Mechanical Engineering	0	10	10	6.85
<b>B. East Sarajevo University</b>			114	78.08
B.1. Department of Mathematics at Pale	0	9	9	6.16
B.2. Teacher's Education Department at Pale	0	1	1	0.68
B.3. Faculty of Teacher's Education at Bijeljina	7	98	105	71.92
<b>C. Independent University at Banja Luka</b>			2	1.37
C.1. Faculty of Teacher's Education	0	2	2	1.37
Totals	12	134	146	100

**Table 5. Distribution of texts according to the research domain**

Research Domain	Number	Percentage (%)
Pre-Schools Math.	4	3.6
Elem. Schools Math. (1–5)	44	40.0
Middle Schools Math. (6–9)	0	0
High Schools Math. (10–13)	4	3.6
Undergraduate Math.	36	32.73
Other	22	20.0
Total	110	100.0

The data in Table 5 are particularly useful in finding gaps in the research conducted in the RS. As such, we display it graphically in Figure 1, to clearly show areas where future research is likely to be fruitful.

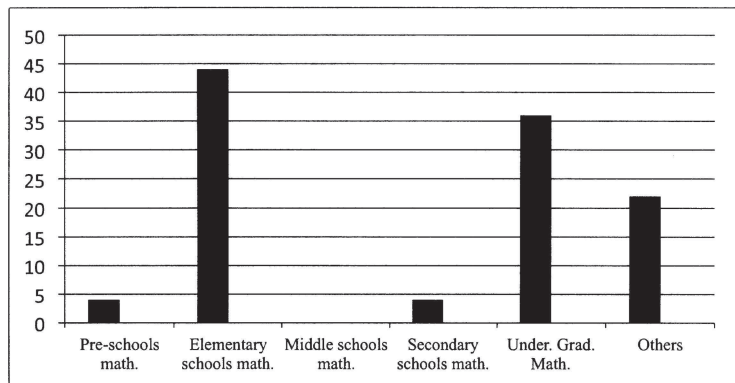


Figure 1. Visualization of distribution of the published texts according to the research domain

### Data Analysis and Discussion

One of the aims of the research in mathematics education is to study the factors affecting the teaching and learning of mathematics and to develop programs to improve the teaching of mathematics [1, 7, 30]. In order to accomplish this aim, the field of mathematics education must consider the contributions of several disciplines: Psychology, Pedagogy, Sociology, Philosophy, etc. [9, p. 127]. However, the use of these contributions in Mathematics Education should be based on an analysis of the nature of mathematics and mathematical concepts, and their personal and cultural development. Such epistemological analysis is essential in Mathematics Education, for it would be very difficult to suitably study the teaching and learning processes of undefined and vague objects. However, the use of the contributions of these disciplines in mathematics education should be based on an analysis of the unique nature of mathematics, mathematical concepts, processes and procedures, giving a special feature in the analysis of phenomena in mathematical education. An example of this would be specific scientific language and categorical terms in this domain as well as the specialized theories of mathematical education. Of course, our domain specifies various forms of mathematical thinking (logical thinking, set-relations thinking, geometric thinking, early algebraic and algebraic thinking). Such specific terms are not known in other subject didactics.

In the data we analyzed, there is only one article on the research necessary for mathematical and methodical competency of primary school teachers [25]. Particularly interesting is the distribution of the articles by author affiliation. The authors (teachers, teacher assistants and graduate students) from the Faculty of Teacher's Education at Bijeljina are extraordinary groups of researchers. They stand out as a particularly productive group of researchers in mathematics education in RS. In the observed period they have published 105 articles of total 146 published texts.

According to the data collected, teachers and staff of departments of mathematics within the two public universities are not involved (e.g., University of Banja



Luka) or negligibly engaged (e.g., University in East Sarajevo) in research in mathematics education, although this would fit their regular duties.

From a total of 110 works, 44 of them, or 40%, are research in mathematics education in the lower grades of elementary school. Unfortunately, in the reporting period there is not a registered research study of mathematics education in the upper grades of elementary school although, at the discretion of the authors of this text, it is an area of school mathematics fraught with significant shortcomings since it is the most sensitive for teaching. A similar situation, as in the previous case in the investigation, is in secondary mathematics because in the reporting period we found only 4 published texts.

### **Final observations and impressions of the RS mathematics education community**

The community of the Republic of Srpska researchers in mathematics education is heterogeneous (Elementary school teachers, Secondary school math teachers, university math professors, school counselors, and university professors of pedagogy). It seems that there is a mutual understanding between these different groups on intent and purpose of research in mathematics education. There is significantly less mutual understanding of how we should conduct this research, and there is a total disagreement about what is accepted as a quality contribution to such research. There is a strong expression of rejection of research in mathematics education by pure mathematicians, as this topic must not be something valid or significant in their scientific profession. A significant number of secondary school mathematics teachers are not engaged in researching their own practice, although it is a venue worth pursuing.

Most research in mathematics education in the RS area has taken an intuitive approach to this research, working from convenience rather than building on past research. Additionally, most researchers are not pressed to utilize any of the known theories of mathematics education. Unfortunately, most university teachers of mathematics and secondary mathematics teachers in the RS are convinced that their own knowledge, rather than the core principles of the domain, can successfully conduct research in mathematics education. They are, in fact, using the colloquial language rather than specific scientific language of this domain. Evidence for this is that the Departments of Mathematics at our two public universities do not have a Chair of Teaching Mathematics or a study on research in mathematics education at the second cycle.

Finally, the departments of mathematics at our two public universities do not permit doctoral candidates to conduct and defend a doctorate in the field of research in mathematics education. If the RS is to attain notice of our research beyond local publications, the faculty at all of the universities would do well to study the plethora of research already conducted concerning the value and need for doctoral-level research in mathematics education [20–23].

To inform the mathematics teaching community, it makes sense to ask: *Which and what indicators of mathematics teaching can we identify by collecting and an-*

*alyzing published articles in the field of research in mathematics education?* Of course, in this case study we have not offered an answer to this question but believe it would be a productive avenue of research. We would like to note that during the monitoring period, 146 authors published 110 texts, which is quite a feat. However, 72% of the authors of the texts are from one college for the education of teachers. This shows that there is a lot of room for growth in the research capacity within the RS.

Based on this analysis of the current state of research, we are interested to see some research along the lines of the following questions within the RS: Is there interest in research in mathematics education? What ongoing research of in-service curricula for mathematics education exists? Is there an analysis of school textbooks for mathematics (see [8] for an example)? What social, academic and professional orientations are present in the realization of mathematical education? How can we begin to understand the philosophy of mathematics education that is present in the mathematics education? Which theory of mathematical education is favored by mathematics educators in the teaching and learning of mathematics?

### 3. Discussion

We believe that this case study has begun to demonstrate the value and merit of publishing in journals that are not necessarily ranked in the surveys of leading scholars in the field or those indexed in electronic databases. Many small countries of the world, and larger countries with coherent regions, are likely to produce similar amounts of publications in the field of mathematics education. These venues are unlikely to ever show up in the large databases such as Scopus, Web of Science, or Google Scholar. Even smaller outlets, such as newsletters of local affiliates of teacher organizations, are useful in the dissemination of knowledge for the improvement of teaching. In compiling the data for this article and providing the analysis of what is currently studied, and pointing out the vast areas that remain to be studied, we hope to inspire those small communities of researchers to begin to speak openly about the benefits such scholarly works have on the regions students and future scholars. For those readers who do not have such a regional community, we encourage them to begin the process of formalizing a meeting system by which similar information and research can be shared.

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