

PLANNED MATHEMATICAL ACTIVITIES IN SLOVENIAN KINDERGARTENS

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Abstract This study aimed to explore the manifestation of planned mathematical activities in Slovenian kindergartens. The study is based on the analysis of the reports written by the third-year full-time students ($n = 57$) of the study program Pre-school Education after completing their integrated practical training in various Slovenian kindergartens. An analysis of the reports showed that during the integrated practical training, which included students' 4 full-day visits in kindergartens, a total of 74 planned mathematical activities were carried out by their mentors. As many as 19.3 % of students did not experience a single planned mathematical activity during their practical training. Activities in arithmetic (41.9 %) and geometry (27.0 %) predominated, while there were much fewer activities related to measurement (13.5 %) and the so-called "other content" area (12.2 %). Activities related to algebra were performed the least (only 5.4 %). The average number of mathematical activities performed in the groups of children aged 1–3 years was much lower ($M = 1.00$) than the average number of mathematical activities performed in the groups of children aged 4–6 years ($M = 1.34$) and in the mixedage groups ($M = 1.41$), but the difference is not statistically significant.

Keywords:

early mathematics, early childhood education, practical training, mathematics areas, preschool educators.

Over the years, after discussing their practical training experiences with pre-service kindergarten teachers and focusing on mathematical activities they had observed in kindergartens, the feedbacks often indicated that mathematics is not as present as other areas of the curriculum. Slovenian Curriculum for kindergartens (Kurikulum za vrtece, 1999) defines six content areas as follows: movement, language, art, society, nature and mathematics. However, the practice is oriented towards the holistic approach to teaching and learning (Marentič Požarnik, 2003, p. 120), and as such, activities in kindergarten strive to blur the boundaries between the areas as much as possible. Nevertheless, recent research findings suggest that the integration of different content areas in Slovenian kindergartens is still far from desired (for example, Antolin Drešar, 2017b). Moreover, in recent research, Antolin Drešar (2017a) examined how future kindergarten teachers perceive the integration of mathematics and other areas of the curriculum during their practical training in kindergartens and found that the integration of mathematics with natural science was perceived the most often, while integration with art was the least perceived among all pairs of possible links. The growing body of research is demonstrating that mathematical skills acquired by children in kindergarten are the best predictor of later academic success for both boys and girls, regardless of their socioeconomic background (see Claessens et al., 2009; Claessens & Engel, 2013; Geary et al., 2013; Ritchie & Bates, 2013). However, according to Ginsburg (2009) and Hachey (2013), the intuitive mathematical skills that children develop naturally are not enough. The US National Research Council (2009) also stresses that early years teaching must be intentional. Despite strong evidence of the importance of early mathematics, many studies have suggested that decidedly limited mathematics is taught in the early years (Bruce et al., 2016; Clements & Sarama, 2007; Hachey, 2013; Lee & Ginsburg, 2007). Phillips et al. (2009), for example, reported that American early-years educators devote a much smaller proportion of the day to mathematical activities compared to literacy and social studies activities.

The research review on pre-school mathematics education in the Slovenian educational environment pointed out research conducted by Nudl et al. (2012); the study examined the amount of mathematical activities in which Slovenian kindergarten children were engaged. The analysis of diaries of mathematical activities written by 130 pre-service kindergarten teachers during their integrated practical training in kindergarten revealed a total of 800 different types of mathematical activities. At first glance, the number seems to be high, but if one considers that each

pre-service kindergarten teacher observed a selected child and recorded each mathematical activity in which the child was engaged, results show that on average, one child participated in 6 mathematical activities in about half a year. However, the total number of mathematical activities may even be overestimated, since it encompasses planned mathematical activities and short, spontaneous activities, such as playing with blocks. In this context, Tepylo et al. (2015) argue that not every playtime activity incorporating blocks can be considered as mathematics-related, even though early years teachers might perceive it as such. Indeed, children may use the blocks in imaginative play or in some other way where they do not focus on the mathematical ideas implicit in the blocks.

Mathematical Content Areas in Kindergarten

Early childhood mathematics education can be very broad and could include a comprehensive collection of mathematical activities covering various mathematical content areas such as arithmetic, algebra, geometry, measurement and the so-called “other content” area. However, the literature review indicates that early teaching and learning of mathematics is often limited to very basic content such as counting (e.g. Bargagliotti et al., 2009; Ginsburg et al., 2008; Nudl et al., 2012; Rudd et al., 2008). According to Reys et al. (2008), kindergarten mathematics standards and practice in kindergarten classes emphasize early numeracy skills over more advanced mathematics skills. In addition, Engel et al. (2013) reported that teachers devoted the most mathematics time to basic counting and recognition of simple geometric shapes, although the vast majority of children mastered this already when they entered kindergarten. One study in the US, in which more than 400 early child care providers answered questions about their main mathematics activities, showed that 67 % of them chose counting, 60 % sorting, 51 % recognizing numbers, 46 % patterning, 34 % number concepts, 32 % spatial relations, 16 % creating shapes, and 14 % measuring (Sarama, 2002). As this study shows, geometry and measuring were the least popular. Similar findings are reported by Nudl et al. (2012) on the representation of mathematical activities in Slovenian kindergartens, which indicates that geometry and measuring activities were performed least often. Clements and Sarama (2007) also reported that geometry and spatial thinking are often ignored or minimized in early education.

Multiple reasons may contribute to the imbalance of content areas. According to Lee and Ginsburg (2007), teachers of young children often underestimate children's interests and abilities and assume that simple concrete concepts such as counting with small numbers is the maximum of the children's capabilities. Moreover, Lee and Ginsburg (2007) also pointed out that early childhood educators do not believe that young children can handle abstract ideas and that they are not ready for various mathematical topics. Consequently, early mathematics is narrowed to basic counting and shapes (Ginsburg et al., 2008). Another reason for focusing on "simple" mathematics may be that kindergarten teachers vary in their understanding of and feelings about efficacy in teaching early mathematics (Copley, 2004; Ginsburg et al., 2008; Greenfield et al., 2009).

Current Study

The study presented in this paper focuses on planned mathematical activities. As mentioned in the beginning, discussions with students after their practical training often pointed to the lack of mathematical activities performed in kindergartens. Accordingly, the main objective of the study was to explore the manifestation of planned mathematical activities in Slovenian kindergartens and thus contribute to getting a better insight into the amount of mathematics that is taught in Slovenian kindergarten classrooms. Furthermore, the aim of the study was to investigate the representation of planned mathematical activities in content areas to see how balanced the content areas are in Slovenian kindergartens.

Method

The study is based on the analysis of written reports submitted by 57 third-year full-time students of the study program Pre-School Education at the University of Maribor, in the academic year 2016/2017, after completing their integrated practical training in various kindergartens throughout Slovenia. The practical training is an important part of the education of future pre-school teachers and is incorporated in all three years of the study program. Part of the practical training is implemented as an integrated practical training and is carried out in each year of the program. As part of the integrated practical training, each student goes to kindergarten one day a week to gain valuable teaching experience by systematically observing various aspects of the educational work. In the academic year of 2016/2017, the integrated

practical training encompassed students' four full-day visits in kindergarten. In the framework of Mathematics Education (the course is held in the last semester of the study program) the students are instructed to observe mathematical activities that take place during the integrated practical training. For the purposes of this research, students had to submit reports in which they were required to indicate all planned mathematical activities that were carried out by their mentor. In addition, they had to provide short descriptions of the activities and define the mathematical content area of performed activities.

57 participating students carried out their integrated practical training in 44 different kindergartens in different regions of Slovenia. As Table 1 shows, the majority of students carried out their integrated practical training in the Slovenian Styria region (68.19 %), followed by the Mura region (25.0 %) and three other regions. It should be noted that the majority of students come from Slovenian Styria, where the faculty is located, but some students come from more remote regions such as Upper Carniola, and Coastal-Karst. In recent years, students have been given the opportunity to do their integrated practical training in their home towns, but on the base of the data on kindergartens, it can be concluded that especially those who are very remote did not choose this option and preferred to pursue the integrated practical training practice in the vicinity of the faculty.

Table 1: Frequencies (f) and relative frequencies (f %) of kindergartens in which pre-service kindergarten teachers completed their integrated practical training regarding regions of Slovenia

Regions	f	f %
Slovenian Styria	30	68.19
Mura	11	25.0
Carinthia	1	2.27
Central Sava	1	2.27
Southeast Slovenia	1	2.27
Total	44	100.00

Most of the participating students carried out the integrated practical training in the senior kindergarten age group (50.9 %), 19.3 % in the younger age group and 29.8 % in the mixed-age classes. Regarding the location of the kindergartens, the majority of students completed their practical training in urban kindergartens (54.4 %), while the rest of them attended practical training in rural and suburban kindergartens (45.6

%). The final reports of the students on integrated practical training were analysed, as they represent a rich source of information on mathematics that is taught in Slovenian kindergartens. Students' reports were thoroughly reviewed and all the planned mathematical activities listed in the students' reports outlined. Students were explicitly instructed to follow the planned mathematical activities. The review of the reports revealed that they followed the instructions and did not include spontaneous mathematical activities (such as counting in the morning circle) in their records. Given the short description of the activities, it was checked whether students properly defined the content area of each mathematical activity and modified if necessary. Table 2 shows some specific examples from the students' reports that illustrate correctly defined content areas.

Table 2: Examples of planned mathematical activities that were listed in students' reports and properly defined content areas

Age group	Mathematical activity	Short description	Properly defined content area
3–6 years (mixed age group)	Dots for ladybugs	The teacher read a fairy tale titled Dotless Ladybugs. She made paper ladybirds with 7 outlined but blank dots. She prepared a black stamp and a larger dice. The child came to the centre of the circle, rolled the dice, recognized the number of dots and printed with the stamp as many dots as had fallen on the dice. The next one had to think about how many dots were missing so that the ladybug would have 7 dots.	Arithmetic
5–6 years (senior age group)	Colors of the T-shirts	Children sat in a circle and looked at the colors of their T-shirts. Each child had to say what color his T-shirt was, and then he got a small sheet with the matching color. If the child had a colorful or striped T-shirt, the kindergarten teacher drew lines on his or her sheet. Then they made a bar chart on the floor using their color sheets. They discussed how many children had red T-shirts, how many yellow T-shirts, etc.	“other content” area
1–2 years old (younger age group)	Measuring and baking	The kindergarten teacher showed the children how to measure the ingredients for bread with cups and spoons (e.g. 4 cups of flour, 2 cups of water, 3 teaspoons of salt).	Measurement

In Table 3 we can see a few examples of mathematical activities where students have not defined the content areas adequately. In these cases, they have been corrected as is illustrated below.

Table 3: Illustration of planned mathematical activities where the content areas were inadequately defined and needed to be corrected

Age group	Mathematical activity	Short description	Inadequately defined content area	Properly defined content area
2–3 years old (younger age group)	Creating symmetry	The kindergarten teacher presented the children with an A3 size sheet. She folded the sheet and asked them if the sheet was the same. Then she invited them to create symmetry. The children used the folded A3 sheet and painted something on one half, which was then printed on the other half to create symmetrical pictures.	Algebra	Geometry
5–6 years (senior age group)	Ludo with the big dice	Children played the board game Ludo, but in a slightly different way than usual. Instead of using normal dice, the kindergarten teacher prepared large dice with dots arranged in patterns that can be found on subitizing dot cards.	Numbers	Arithmetic
3–5 years (mixed age group)	Making a house using shapes	The children first cut out shapes and then they made a house from these shapes (squares, triangles and rectangles). Then they built houses using paper strips of different lengths and thicknesses.	Shapes	Geometry

After all students' reports were reviewed and content areas modified if necessary, the data was processed using the SPSS program for data processing and analysis.

Results

The results of this study are presented in three parts. The first part reports on the findings that relate to the amount of performed planned mathematical activities in Slovenian kindergartens. The second part presents the results on the manifestation of the planned mathematical activities among different age groups of children. The last part of the results relates to the representation of different mathematical content areas among the planned mathematical activities performed by Slovenian kindergarten teachers.

Performed planned mathematical activities

The results showed that during the integrated practical training 57 students recorded a total of 74 planned mathematical activities carried out by their mentors. The result, therefore, indicates that during the students' four full-day kindergarten visits, the kindergarten teachers, on average, carried out one planned mathematical activity ($M = 1.30$). Table 4 shows that in no cases the number of planned activities carried out by early childhood educators exceeded the number of 3 (14.0 % of pre-service teachers reported 3 planned mathematical activities to be performed during their integral practice in the kindergarten). The largest proportion of students (45.6 %) detected only one planned mathematical activity during their practical training, while 21.1 % of students recorded two planned mathematical activities. The most striking result was that as many as 19.3 % of students did not see a single planned mathematical activity during their practical training.

Table 4: Frequencies (f) and relative frequencies (f %) of performed planned mathematical activities reported by pre-service kindergarten teachers

Number of activities	f	f %
0 activities	11	19.3
1 activity	26	45.6
2 activities	12	21.1
3 activities	8	14.0
Total	57	100.0

Note. A total of 74 planned mathematical activities were reported.

Planned mathematical activities among different age groups of children

This study focused on the manifestation of planned mathematical activities among different age groups of children.

Table 5: Frequencies (f) and relative frequencies (f %) of performed planned mathematical activities reported by pre-service kindergarten teachers among different age groups of children

Number of activities	Children aged 1–3 years		Children aged 4–6 years		Mixed age group		Total	
	<i>f</i>	<i>f</i> %	<i>f</i>	<i>f</i> %	<i>f</i>	<i>f</i> %	<i>f</i>	<i>f</i> %
0	3	27.3	6	20.7	2	11.8	11	19.3
1	6	54.5	11	37.9	9	52.9	26	45.6
2	1	9.1	8	27.6	3	17.6	12	21.1
3	1	9.1	4	13.8	3	17.6	8	14.0
Total	11	100.0	29	100.0	17	100.0	57	100.0

The study showed that as many as 27.3 % of pre-service kindergarten teachers reported that they did not observe a single planned mathematical activity in the group of youngest children aged 1–3 years. If this is somehow understandable in the youngest group, it is quite surprising that more than one-fifth of the participating pre-service kindergarten teachers (20.7 %) found that no mathematical activity was performed in the group of the senior kindergarten children. In all groups of children, regardless of the age of the children, pre-service kindergarten teachers most frequently recorded 1 planned mathematical activity to be performed during their integral practice in the kindergarten. Two planned mathematical activities most frequently occurred in the group of senior kindergarten children (reported by 27.6 % of pre-service kindergarten teachers), while three planned mathematical activities were most frequently observed in the mixed age group (17.6 %) (see Table 5).

Table 6: Arithmetic means of planned mathematical activities performed in different age groups of children

Age group	Mean	<i>N</i>	Std. Deviation
Group of children aged 1–3 years	1.00	11	0.894
Group of children aged 4–6 years	1.34	29	0.974
Mix age group	1.41	17	0.939
Total	1.30	57	0.944

$F = 0.699; p = .501$

As Table 6 shows, the average number of mathematical activities performed in the groups of children aged 1–3 years was much lower ($M = 1.00$) than the average number of mathematical activities performed in the groups of children aged 4–6 years ($M = 1.34$) and in the mixed-age groups ($M = 1.41$). However, the difference is not statistically significant ($F = 0.699$; $p = .501$).

Regarding the location of the kindergartens (see Table 7), this study revealed that the average of planned mathematical activities performed was slightly higher in rural and suburban kindergartens ($M = 1.31$) than in urban kindergartens (1.29), but the difference is not statistically significant ($F = 0.241$; $p = .787$).

Table 7: Arithmetic means of planned mathematical activities performed regarding the location of kindergartens

Location of the kindergarten	Mean	<i>N</i>	Std. Deviation
Rural and suburban kindergartens	1.31	26	0.788
Urban kindergartens	1.29	31	1.071
Total	1.30	57	0.944

$F = 0.241$; $p = .787$

Planned mathematical activities regarding content areas

This research was focused on the manifestation of the planned mathematical activities, as well as representation of the individual mathematical content areas.

Table 8: Frequencies (*f*) and relative frequencies (*f* %) of performed planned mathematical activities regarding different mathematical content areas

Content area	<i>f</i>	<i>f</i> %
Arithmetic	31	41,9
Algebra	4	5,4
Measurement	10	13,5
Geometry	20	27,0
“Other content” area	9	12,2
Total	74	100,0

As shown in Table 8, the results indicate that in terms of mathematics content areas, arithmetic activities prevailed (41.9 %), followed by activities associated with geometry (27.0 %). The activities related to measurement (13.5 %) and “other content” area (12.2 %) were performed to a much lesser extent. Activities in the field of algebra were most rarely conducted (only 5.4 %).

The study further focused on the manifestation of planned mathematical activities in different age groups regarding mathematical content areas.

Table 9: Arithmetic means of planned mathematical activities performed in different age groups regarding mathematical content areas

Age group		Arithmetic	Algebra	Measurement	Geometry	“Other content” area
Children aged 1–3 years	Mean	0.45	0.00	0.00	0.45	0.09
	Std. Dev.	0.522	0.000	0.000	0.688	0.302
Children aged 4–6 years	Mean	0.48	0.07	0.28	0.34	0.17
	Std. Dev.	0.634	0.258	0.528	0.553	0.384
Mixed age group	Mean	0.65	0.12	0.12	0.29	0.18
	Std. Dev.	0.702	0.332	0.332	0.470	0.393
Total	Mean	0.53	0.07	0.18	0.35	0.16
	Std. Dev.	0.630	0.258	0.428	0.551	0.368

This research indicates that in the groups of the youngest children (aged 1-3 years) no activity in the field of algebra or measurement was performed (see Table 9). The most frequently performed planned mathematical activities in the groups of children aged 1–3 years were activities in the field of arithmetic ($M = 0.45$) and geometry ($M = 0.45$).

The highest average of performed arithmetic activities was observed in the mixed age groups of children ($M = 0.65$). Since algebra is often considered to be one of the most challenging contents, activities related to algebra would be expected to be most often performed in the group of older children, but our results show otherwise. In the mixed age groups, the average number of activities related to algebra was higher ($M = 0.12$) than in the group of the oldest children ($M = 0.07$). Moreover, measuring activities were most often performed in a group of older children ($M = 0.28$).

Discussion and Conclusion

The results of this research confirmed the assumption that arose based on annual discussions with prospective kindergarten teachers regarding their observations of the lack of mathematical activities in Slovenian kindergartens. Thus, the findings indicate that there are relatively few planned mathematical activities. Most pre-service kindergarten teachers reported that only one planned mathematical activity had been performed during their integrated practical training. However, the most worrying is the finding that nearly one-fifth of all prospective kindergarten teachers did not see a single planned math activity during their integral practice. It should be noted that the participating kindergartens were informed about the purpose of students' integral practice and that students previously disclosed with their mentors that they were instructed to specifically observe and record planned mathematical activities. From this point of view, it would be expected that, as a result, kindergarten teachers might show more engagement and therefore perform more planned mathematical activities than they would otherwise. Where to look for reasons? The analysis of students' reports that reflected students' experiences and feelings regarding practical training might reveal at least a few of them. For example, Ana wrote: "*Already at the beginning of practical training, my mentor told me that she was quite weak in mathematics so she was very glad when I shared with her some ideas and activities we learned in Mathematics Education.*" A similar reason was reported in the study conducted by Ginsburg et al. (2001), who stated that early childhood educators may not feel comfortable or competent enough to teach mathematics. On the other hand, Ginsburg et al. (2008, p. 10) noted that "most early childhood teachers do not place a high value on teaching mathematics." In our research, quite a few pre-service teachers expressed their disappointment regarding the modest amount of planned mathematical activities. According to their observations, some teachers do not carry out planned mathematical activities because they are incorporating mathematics in

various situations during the day. Thus, Nina stated: *"As a negative experience, I would point out that my mentor considers morning circle as a mathematical activity and for this reason, she does not carry out planned mathematical activities."* Eva's observations are similar: *"I noticed that in my group mathematics was often involved in spontaneous conversations and during spontaneous play, while planned mathematical activities hadn't been performed, not even once."* It seems that kindergarten teachers are not aware (enough) that the play does not suffice and that mathematics should be presented to the children in a planned way (Moss et al., 2016).

In connection with the research of Nudl et al. (2012), which reported on the frequency of mathematical activities in Slovenian kindergartens, quite a few parallels can be observed. Despite the fact that the present research was carried out 7 years later and focused only on planned activities, it showed almost identical findings regarding the representation of mathematical content areas. Similar to their research, this research indicated the predominance of arithmetic activities as well. Ginsburg et al. (2008) pointed out that limiting early mathematics to counting most likely stems from an underestimation of children's abilities. Furthermore, in accordance with Nudl et al. (2012), this research showed that the least frequently performed activities were in the field of algebra. However, in contrast, the present study revealed progress in the frequency of performed geometric activities. Namely, compared to the 14.0 % rate of geometric activities detected in the research conducted by Nudl et al. (2012), present findings suggest that as much as 27 % of all planned activities were associated with geometry. Considering that some previous studies revealed that geometry is typically the least known subject for early years teachers (such as Clements & Sarama, 2011; Lee, 2010), the findings of this study are quite encouraging.

There are certain limitations of this study that should be considered. First, the manifestation of planned mathematical activities was investigated by analyzing pre-service kindergarten teachers' reports. It would certainly be better if the observations could be carried out directly by the researcher, but in that case, it would be very difficult to cover as many different kindergartens across Slovenia as the current method allowed. Furthermore, in the academic year of 2016/17, the integrated practical training included only 4 full-day kindergarten visits (4 consecutive Fridays). Taking into consideration that some kindergartens may have had other activities previously planned for those days, that could contribute to the relatively low number

of mathematical activities recorded. From this point of view, it might seem that it would be better to analyze students' reports from their concise 4-week internship. However, that data is unlikely to provide a deeper insight since during the concise internship, students are required to carry out several activities covering all curriculum content areas and therefore the learning process in kindergartens is at that time often adopted to accommodate students' internship agenda.

This study pointed out the crucial importance of finding ways how to encourage Slovenian kindergarten teachers to pay more attention to planned mathematical activities. First and foremost, there is a need to raise awareness that the development of intuitive mathematics skills is not enough (Ginsburg, 2009; Hachey, 2013). In addition to promoting awareness of the importance of planned activities, seminars and workshops for kindergarten teachers should remind them of the problematic narrowing of mathematics to numbers and operations (Lee & Ginsburg, 2007) and encourage them to include diverse activities covering other mathematical content areas as well. Furthermore, until recently, there were not many Slovene-language materials on early mathematics available for early childhood educators. The publication of literature that reaches kindergartens and early childhood educators (for example Lipovec & Antolin Drešar, 2019) might at least assist them with new ideas and approaches when planning mathematical activities.

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