

Increasing Pre-service Kindergarten Teachers' Mathematics Teaching Efficacy through Lesson Study

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Abstract

The study aimed to investigate the effects of Lesson Study on the self-efficacy beliefs of pre-service kindergarten teachers. A quasi-experimental design with two parallel groups was used. The sample consisted of 49 students divided into a control group (27) and an experimental group (22). The pre-service kindergarten teachers in the experimental group followed an adjusted Lesson Study design, while the control group followed the traditional way of pre-service teaching practice. Findings indicate that there was no significant difference in teacher self-efficacy total scores between the groups, but there was a significant difference in the self-reported competence to effectively teach mathematics lessons and ability to get and keep pupils motivated.

Keywords: *lesson study, pre-service kindergarten teachers, teacher efficacy beliefs, self-efficacy*

Introduction

Research has shown that teacher efficacy beliefs present an important factor in teacher effectiveness related to teaching behaviours and students' outcomes (Tschannen-Moran & Hoy, 2001) and that it can be most easily influenced by the experience gained in early years of teaching (Bandura, 1995), such as during preservice teaching practice. Teacher education programmes have an impact on

in-service teachers' practice, but it sometimes takes years for the impact to appear in practice. In order to help future teachers to build professional competences and confidence in a relatively short period of time and to bridge the gap between pre-service methods courses and in-service teaching in a regular school classroom, university educators are looking for effective approaches to foster pre-service teachers' learning in methods courses and enable successful transition to in-service teaching. Lesson Study is recognized as a "cohesive professional development tool" for providing high-quality learning experiences for future teachers (Murata & Pothan, 2011).

Theoretical Background

Lesson Study

Lesson Study (LS) is defined as "a systematic investigation of classroom pedagogy conducted collectively by a group of teachers rather than by individuals, with the aim of improving the quality of teaching and learning" (Tsui & Law, 2007, p. 1294). The main idea is to bring together teachers for carrying out the process of planning a lesson, teaching the lesson with LS group observing, and then examining and discussing the lesson during a debriefing session. During the lesson preparation phase, teachers try to predict pupils' reactions to specific activities, which requires teachers to reflect on and reassess the chosen teaching approaches (Coenders & Verhoef, 2018). After a research lesson, during a debriefing session, observations are discussed regarding the predicted outcomes. Based on the group's comments during the debriefing session, the lesson is revised, re-taught and reflected on again before being polished (Tsui & Law, 2007). The main influence of reflection goes beyond improvement of a single lesson since it includes a deeper understanding of the content knowledge and how pupils learn, and contributes to teachers' improved pedagogical skills. Since the focus is on the research lesson, on pupils' learning and progress, and not on the teacher, it encourages open and frank discussions about the lessons.

Although the majority of research on LS is focused on in-service teachers, there are indications that some adapted versions of LS can be effectively used with pre-service teachers (Burroughs & Luebeck, 2010; Chassels & Melville, 2009; Cohan & Honigsfeld, 2006; Mostofo, 2014; Sims & Walsh, 2009). For pre-service teachers, LS offers opportunities such as: building professional learning communities, deepening and broadening their understanding of content knowledge and pedagogy, developing habits of critical and constructive observation, analysis, and

improving the ability to both provide and receive feedback (Chassels & Melville, 2009; Mostofo, 2014). Some studies point out that the collaborative aspect of participating in LS through planning and debriefing sessions can enhance teacher efficacy and lead to pupils' improved engagement and learning (Ylonen & Norwich, 2014). Lesson Study helps participants to gain new insights into teaching and how to improve their teaching strategies (Rock & Wilson, 2005). Moreover, collaborative planning, teaching, debriefing, revising and re-teaching during the LS process increases pre-service and in-service teachers' confidence to teach mathematics (Matanluk, Johari & Matanluk, 2013; Villalon, 2016).

Teacher Efficacy

Teacher efficacy belief is defined as the extent to which teachers believe they can have a positive effect on pupils' performance (Gavora & Wiegerová, 2017, Tschannen-Moran & Hoy, 2001). It has two dimensions: personal (or self-efficacy) and outcome expectancy. Personal teaching efficacy is defined as a belief in individual's own ability to teach effectively, while teaching outcome expectancy is a belief that effective teaching will affect pupils' learning positively regardless of external factors (Enochs, Smith, & Huinker, 2000). Research on teacher efficacy indicates that it influences teachers' behaviours such as persistence on a task, risk taking, use of innovations and of more student-centered teaching strategies, effort invested in teaching and the goals they set, and greater enthusiasm and commitment for teaching (Enochs, Smith, & Huinker, 2000; Gavora & Wiegerová, 2017; Martins, Costa & Onofre, 2015; Tschannen-Moran & Hoy, 2001). Teacher efficacy is also related to student outcomes such as achievement and motivation (Tschannen-Moran & Hoy, 2001). Sibbald (2008) found a strong link between LS and self-efficacy. He determined that the collaboration in LS broadens both the content and pedagogical repertoires of the participants. Rock and Wilson (2005) reported that all participants in LS experienced an increase in their professional confidence. Teachers who have confidence in their own teaching abilities show strong personal efficacy beliefs (Enochs, Smith & Huinker, 2000; Mostofo, 2014).

Over the past decades, teacher efficacy emerged as a significant concept in teacher education. Research indicates that self-efficacy of student teachers significantly changes after one year of teacher education (Canrinus & Fokkens-Bruinsma, 2014) and is increased through practicing skills or activities in real or simulated experiences (Starko & Schack, 1989). Collaboration, interpersonal support and participation in self-reflection, which are important aspects of LS, have also been associated with higher teacher efficacy, especially of novice teachers (Mostofo, 2014; Tschannen-Moran & Hoy, 2001).

The important aspect of the presented study lies in the fact that it contributes to expanding the existing body of knowledge related to changes in mathematics teachers' self-efficacy in relation to the use of LS in teacher education. The use of LS with pre-service kindergarten teachers in our study, but also in the Serbian educational context, was the innovation that was used to link the mathematics methods classroom with field experience teaching. Future kindergarten teachers who are involved in teaching practice through practicum lessons in the course of their studies, often experience lack of confidence in their teaching competences. The aim of the study was to investigate the effects of adjusted LS on pre-service kindergarten teachers' self-efficacy in teaching mathematics lessons.

Research Methodology

The presented study was conducted at the Faculty of Education (FE), University of Kragujevac, Serbia, as a part of larger scale research on effects of LS on teaching anxiety, teacher efficacy and teaching competences of pre-service kindergarten teachers. Considering that the survey instruments were administered and numerical data were collected, a quantitative method was used in analyzing data. Data were collected with the use of a questionnaire, which represents a common technique in educational research. A quasi-experimental design with pre-tests and post-tests was used in the study because the convenience sampling procedure was followed. A convenience sample represents a group of subjects who are selected on the basis of the accessibility or expediency. All the participants in our study were enrolled in Mathematics Teaching Practicum (MTP) course (two semesters in the 4th year of bachelor's studies) at the Kindergarten Teachers Education Programme, which lasts four years. During the MTP course, which is obligatory for all student teachers, pre-service teachers spend three hours a week in a local kindergarten observing and teaching mathematics concepts lessons. They are guided by their supervisor, a university teacher. Every student teacher must conduct two mathematics concepts lessons in a regular classroom.

Research Sample

The research sample involved 49 pre-service kindergarten teachers. The study was conducted during the 2017/2018 academic year, and it lasted 20 weeks (two semesters). The student teachers were divided into a control group (CG) and an experimental group (EG). The EG consisted of 22 student teachers (21 females and 1 male) and the CG consisted of 27 female student teachers. All the students of

both groups had successfully finished a Mathematics Teaching Methods (MTM) course in their third year of bachelor's studies.

Instrument

The instrument used was a questionnaire, which consisted of two parts. In the first part, background information about the student teachers was collected (age and MTM course grades). The second part of the instrument contained a Preservice Kindergarten Mathematics Teaching Self-Efficacy Beliefs Scale (PMTSE), which was developed by the author and aimed to determine the level of the pre-service kindergarten teachers' self-efficacy in teaching mathematics. The items were constructed in accordance with some previous studies and literature. PMTSE is a five-point Likert-type scale containing 6 items. The Cronbach alpha reliability coefficient of the PMTSE indicated acceptable reliability ($\alpha=0,775$).

The items included in the PMTSE concerned different aspects of mathematics teaching self-efficacy, such as: beliefs in the individual's ability to effectively plan and prepare mathematics lessons, beliefs in the individual's ability to successfully perform instructional activities, and competence to teach mathematics lessons effectively. The beliefs about the ability to successfully perform instructional activities referred to the student teachers' confidence in their content and pedagogy knowledge and skills, and to the ability to motivate students and keep them interested (Table 1).

Table 1. PMTSE items

Items code	Items
TE1	I am sufficiently methodologically trained to independently plan and prepare mathematics lessons in kindergarten.
TE2	I am sufficiently methodologically trained to successfully use appropriate teaching methods and techniques in work with kindergarten pupils.
TE3	I will be able to get and keep my kindergarten pupils motivated and interested while working on mathematics tasks.
TE4	My knowledge and understanding of kindergarten mathematical concepts is good enough to secure my effective teaching of lessons to kindergarten pupils.
TE5	If a child does not understand some mathematical concepts, I believe that I will know how to explain it to her/him successfully.
TE6	I feel competent enough to effectively teach mathematics lessons in kindergarten.

Procedure

The pre-service kindergarten teachers in the CG used the traditional model of MTP course. This means that the student teachers individually planned and prepared lessons, and after consulting with their supervisor and upon final lesson plan corrections, they taught the lesson in a regular classroom. Other student teachers in the CG observed the lessons taught by a student teacher, and participated in a debriefing session afterwards.

At the beginning of the MTP course, all the student teachers from the EG were introduced to the planned LS process. The adjusted LS involved two phases. In the first phase, teams consisting of two or three student teachers were chosen randomly. Each team was assigned to teach a particular mathematics concept unit. The lesson planning process was conducted cooperatively by the teams. They used team teaching, both to teach a simulation in MTP classroom settings and a revised lesson in a regular kindergarten classroom. Team teaching was used in order to decrease the student teachers' stress when being observed by their peers (Mee & Oyao, 2013). In the second phase, each student teacher was assigned a new mathematics concept unit. In this phase, each student teacher worked individually on lesson planning and firstly taught the lesson in a simulated environment in the MTP classroom. After a debriefing session, revision of the lesson was planned and carried out collaboratively. The same student teacher then re-taught the revised lesson in a regular classroom.

All the student teachers had one week for preparing both simulation and an actual classroom lesson. Each student teacher (or team) taught for about 20 minutes in a simulated environment in the MTP course. During the lesson simulations, in both phases, other student teachers in the EG acted as typical kindergarten children. The debriefing session with the whole group followed immediately after the simulation or a regular lesson. At the beginning of the debriefing session, the student teacher (or team) who taught the lesson performed self-reflection. The self-reflection was followed by the other student teachers' questions, comments, and suggestions for lesson revision. This discussion was guided by the supervisor, who gave feedback at the end. Afterwards, the lesson was revised based on the received feedback. The revised lesson plan was sent to the supervisor for final approval before teaching in a regular classroom. Regular lessons in a local kindergarten were followed by a debriefing session with the whole group of student teachers and received final evaluation by the supervisor.

Results and Discussion

The two groups were checked for equivalency in their academic achievement in the MTM course at the beginning of the research. The results suggested that the groups were homogenous in terms of their MTM grades (Table 2).

Table 2. Pre-service kindergarten teachers achievement in MTM course

Group	Median	Mean Ranks	Sum of Ranks	Shapiro-Wilks test		Mann-Whitney test		
				W	Sig.	U	Z	Sig.
CG	7.50	24.04	577.00	0.893	0.016	251.00	-0.294	0.768
EG	7.00	22.91	504.00	0.866	0.007			

The pre-service kindergarten teachers' scores on the PMTSE, before and after implementation of LS, were calculated. Analysis of the findings showed that there was no significant difference between the teacher self-efficacy scores of the CG and EG in pre-test (Table 3). Furthermore, there were no significant differences in scores on single items either. The CG and EG were homogenous in terms of their mathematics teaching self-efficacy.

Table 3. Mathematics teaching self-efficacy of CG and EG in pre-test

Items	Group	Median	Mean Ranks	Sum of Ranks	Shapiro-Wilks test		Mann-Whitney test		
					W	Sig.	U	Z	Sig.
TE1	CG	3.00	24.67	666.00	0.724	0.000	288.000	-0.200	0.841
	EG	4.00	25.41	559.00	0.854	0.005			
TE2	CG	4.00	23.74	641.00	0.813	0.000	263.000	-0.746	0.456
	EG	4.00	26.55	584.00	0.681	0.000			
TE3	CG	4.00	21.93	592.00	0.777	0.000	214.000	-1.925	0.054
	EG	4.00	28.77	633.00	0.757	0.000			
TE4	CG	3.00	24.67	666.00	0.799	0.000	288.000	-0.203	0.839
	EG	3.00	25.41	559.00	0.739	0.000			
TE5	CG	3.00	24.30	656.00	0.718	0.000	278.000	-0.433	0.665
	EG	4.00	25.86	569.00	0.713	0.000			
TE6	CG	3.00	24.69	666.50	0.799	0.000	288.500	-0.831	0.406
	EG	4.00	25.39	558.50	0.685	0.000			
Total score	CG	21.00	23.48	634.00	0.969	0.563	256.000	-0.831	0.406
	EG	22.00	26.86	591.00	0.876	0.012			

At the end of the second semester, both groups were given a post-test. The post-test contained the same 6 items scale that was used in the pre-test at the beginning of the first semester. The results of CG and EG in post-test are shown in Table 4.

Table 4. Mathematics teaching self-efficacy of CG and EG in post-test

Items	Group	Median	Mean Ranks	Sum of Ranks	Shapiro-Wilks test		Mann-Whitney test		
					W	Sig.	U	Z	Sig.
TE1	CG	5.00	22.74	614.00	0.708	0.000	236.000	-1.473	0.141
	EG	5.00	27.77	611.00	0.569	0.000			
TE2	CG	5.00	24.65	665.50	0.549	0.000	287.500	-0.256	0.798
	EG	5.00	25.43	559.50	0.533	0.000			
TE3	CG	5.00	22.02	594.50	0.626	0.000	216.500	-2.068	0.039
	EG	5.00	28.66	630.50	0.422	0.000			
TE4	CG	4.00	22.31	602.50	0.728	0.000	224.500	-1.667	0.095
	EG	5.00	28.30	622.50	0.729	0.000			
TE5	CG	4.00	24.15	652.00	0.752	0.000	274.000	-0.224	0.823
	EG	4.00	24.95	524.00	0.640	0.000			
TE6	CG	5.00	21.63	584.00	0.718	0.000	206.000	-2.207	0.027
	EG	5.00	29.14	641.00	0.484	0.000			
Total score	CG	27.00	21.30	575.00	0.912	0.026	197.000	-1.828	0.068
	EG	28.00	28.62	601.00	0.822	0.001			

There was an increase between the pre- and post-test total scores in the teaching self-efficacy level of both the EG and CG student teachers. These results are in accordance with some previous studies, which point out that actual teaching experience during students' teaching practice have a greater impact on their personal teaching efficacy (Tschannen-Moran & Hoy, 2001). Nevertheless, the results showed that there was no statistically significant difference regarding teacher self-efficacy in general between the two groups (Table 4), although the EG student teachers showed more growth in terms of teacher self-efficacy comparing to the CG. The teacher self-efficacy scores of the group that had practised LS and the group that had a traditional teaching experience did not differ significantly.

On the other hand, when comparing scores on single items, we determined that there was statistically significant difference between the CG and EG post-test scores in two items. The pre-service teachers in the EG showed significantly higher confidence in the ability to get and keep their pupils motivated and interested during lessons ($U=216.500$; $p=0.039$), i.e., they were more optimistic about their

effectiveness in motivating pupils than the students in the CG. Bandura (1995) suggested that teachers' personal efficacy to motivate pupils is possibly one of the main pathways through which efficacy beliefs affect pupils' cognitive development and academic achievement. On the other hand, as studies suggest, teacher self-efficacy beliefs have been observed as a powerful construct related to pupils' motivation (Mojavezi & Tamiz, 2012; Tschannen-Moran & Hoy, 2001).

Although there was no significant difference in the items concerning confidence in content knowledge and pedagogical skills between the groups, the participants in the EG showed significantly higher confidence in their competence to effectively teach mathematics concept lessons in kindergarten ($U=206.000$; $p=0.027$). Some research also reported that LS implementation increased pre-service teachers' confidence to teach mathematics (Matanluk, Johari & Matanluk, 2013; Villalon, 2016). Increased confidence in one's own teaching ability is associated with strong personal efficacy beliefs (Enochs, Smith & Huinker, 2000).

As for the other items, we have not found statistically significant differences between the EG and CG. This might be due to the fact that the sample size in the study was small. Furthermore, albeit the student teachers participated in LS during the whole academic year (two semesters), the fact that they taught only two complete individual lessons might also have influenced the findings of the study.

Conclusions

The results we obtained show that LS has a positive impact on some aspects of pre-service teachers' self-efficacy beliefs, such as confidence in being competent to effectively teach mathematics concept lessons in kindergarten and the ability to get and keep their students motivated and interested during lessons. However, we have not found statistically significant differences in other items and in self-efficacy beliefs total scores between the groups. The study findings cannot be generalized to pre-service teachers from other courses and universities considering the fact that there are certain limitations such as a small sample size and quasi-experimental design. Nevertheless, the value of this study can be recognized in the fact that there is a lack of literature and empirical evidence on the use and effects of LS on pre-service teachers' mathematics teaching self-efficacy beliefs. The results of this research have significance for both researchers and educators involved in teacher education programmes who are looking for methods that might benefit student teacher education. This further indicates that more attention should be paid to LS and it should become an integral part of teacher education preparation

programmes. Since in our research we focused only on one dimension of teacher efficacy, i.e., pre-service teachers' teaching self-efficacy, in future studies other dimensions, like outcome expectancy, should be investigated. Also, including a qualitative study approach in the form of interview or students' reflective journals, should be considered.

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