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Action research as a potent methodology for improving teaching and learning in mathematics

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This paper represents an effort of the author to better understand teachers' perceptions of their experiences during their engagement in the action research process. In completing their action research projects, teachers not only learned how to conduct research themselves but, also, they shared some of their experiences. The course structure has had the effect of encouraging teachers to try new methods in their teaching, to use new resources and to improve the communication outside class in order to improve their teaching and their students' performance in mathematics. Further, it was discussed about the possibility of involving teachers, both, pre-service and in-service, in the action research studies and the possibility of support for them from the university and the government as an initiative for the successful implementation of education reforms.

Keywords: Action research, teachers, perceptions, improvement, teaching.

Introduction

During the last two decades, the system of education in Kosovo underwent several reforms in order to respond to social, cultural and political developments in the country and broader societal aspirations for integration in European and global processes. Along with ongoing reforms, special attention was paid to the development of education programs for quality teacher training in line with common European principles for teacher competencies and qualifications. Unfortunately, the results from the Programme for International Student Assessment (PISA), conducted in 2015 and in which Kosovo participated for the first time, were quite discouraging. (OECD, 2016). Until recently, the teachers' qualification programs for subject teaching, as well for mathematics were mainly based on subject knowledge, being developed in the academic unit of the University of Pristina. Because the relationship between "academic" and "professional" courses was mostly "bloodless" and teacher training in Kosovo was mainly academic and heavily subject-based (Vula, Saqipi, Karaj, & Mita, 2012, p. 38), the Ministry of Education and Technology in Kosovo made the decision in 2012 to reform the study programs for subject teachers' qualification according to the consecutive model. Thus, all teachers should complete 3 years of academic studies for the respective subject in the relevant academic programs at Bachelor level and 2 years at Masters level at the Faculty of Education, where they have specific training in subject pedagogy and practice teaching. These programs have started to be implemented for the first time in the 2016/2017 academic year. Students enrolled in these programs are those who have no experience in teaching (prospective teachers), but also those who are already mathematics teachers in grades 6-12 and want to advance their qualification at Masters level. Last academic year, the action research course was offered as an elective course, and all of the enrolled students were already teachers. As a course instructor (author), my objective was not only to review the action research projects conducted by teachers but also to better understand the teachers' perceptions in terms of their benefits, experiences as a researcher and their students' benefits during the action research process.

Literature review

Action research is a method used for improving educational practice (Koshy, 2010). Considered as a powerful tool for change and improvement at the local level (Cohen, Manion, & Morrison, 2007), it is any systematic intentional inquiry conducted by teacher-researchers to improve their practice and students' outcomes (Mills, 2013; Cohran-Smith & Lytle, 1993). It is a study process of a real situation in a classroom which assists in teacher education through linking theory and practice (Stenhouse, 1975). According to Elliott (1991), the theoretical understanding of education, knowledge, learning, and teaching are derived from curriculum practices and teachers. Thus, two of the most essential purposes for doing action research are the improvement of the quality of activities or teaching practice and the development and testing of the practical theories that guide one's own practice (Feldman, Altrichter, Posch & Somekh, 2018). According to Koshy (2010), action research is "a constructive inquiry in which the researcher constructs his/her knowledge on specific issues through planning, action, evaluation, refining and learning from experience" (p. 9). It is one of the most essential motives for teachers to improve the quality of their actions and a potent methodology for educational reform (Somekh & Zeichner, 2009). Action research is intended to support teachers with the challenges and problems of practice and carrying through innovations. Somekh and Zeichner (2009) focused on the remodelling of action research theories and practices in response to local cultures. They presented five variations of action research: in times of political upheaval and transition; as a state-sponsored means of reforming schooling; co-option of action research by Western governments and school systems to control teachers; as a university-led reform movement; and as locally-sponsored systemic reform sustained over time. According to Somekh and Zeichner's analyses, a common feature in these variations of action research is the importance each demonstrates of working towards a resolution of the impetus for action with the reflective process of inquiry and knowledge generation, to generate new practices (2009). Improving teaching practice and generating new ones is very important for teachers' everyday work, but action research has impact also on increasing teachers' self-confidence for their role as researchers and fostering collaboration amongst peers in their school environment (Vula & Saqipi, 2015). Action research should be part of both preservice and in-service teachers' professional development programs. Examining the curriculum of action research for teachers' education requires a critical appraisal of the ways in which preservice teachers think critically and creatively about their practical experience to know and understand research and teaching, as well as how they craft their own pedagogies (Capobianco & Ní Ríordáin, 2015). On the other hand, action research curriculums used by in-service teachers are focused on the teachers' own situations, training to validate their own teaching practice. Krainer & Zehetmeier (2013) present an example of a national initiative for fostering mathematics and science education. They have introduced the "lessons learned" from a project that promoted teachers' investigation into their own work. In that project, teachers were key stakeholders in innovation and research. The authors provide exemplary research results for the teachers' critical stance towards innovation and inquiry as an important basis for disseminating inquiry-based learning. The individual and the social dimensions, as well as actions and reflections, should be part of the professional development programs (Zehetmeier, Andreitz, Erlacher, & Rauch, 2015). In addition to the individual engagement of the teacher researchers, it has been shown that teachers are successful and can achieve tremendous results when they co-operate with their colleagues and are supported by the university teachers (Altrichter, Posch & Somekh, 1993). Other

researchers have shown that teachers' perceptions on action research are related with an opportunity for them to deepen their knowledge of the content they provide, to strengthen the pedagogical aspect of the classroom, increase sensitivity to the affective concerns of students and place themselves as creators of knowledge and researchers (Sardo-Brown, 1995; Goodnough, 2011; Vula & Saqipi, 2015). Bonner (2006), in her study of professional development of two teachers, has shown that throughout action research projects, both teachers acquired "richer knowledge" of how to teach mathematics, and "new ways of thinking" about learning about their students, and about themselves (p. 40).

This study aimed to reveal the perceptions of mathematics teachers on the impact of the action research projects on their teaching and students' learning, as well as the benefits of the process itself.

Method

Eleven teachers attended the action research course offered in the spring semester of the 2017/18 academic year. The course was offered to the master degree program for mathematics teaching at the Faculty of Education, University of Prishtina. The course participants (teachers) attended 15 weeks of action research course instructions, applications, and action research methodology. During the course, the teachers were expected to think about a problem or issue they encounter in their classrooms. As part of the course assignment, each teacher was asked to conduct his/her own action research project based on his/her individual classroom students' needs. First, the teachers worked on their research problem, purpose, methodology and literature review. Then, during class discussions, the instructor and the teachers were "critical friends" in regards to the teacher project ideas, the development and implementation of the systematic plan, serving as a validation group for action research projects. They established trusting relationships, which became the grounds for giving and receiving feedback on the validity of the evidence (McNiff & Whitehead, 2009). Later, the teachers conducted their research in their classrooms, where they collected the data, analyzed and further discussed their findings as a final report paper, part of their assignments.

After completing the course, a questionnaire with three open-ended questions was sent to them via email. The questions were related to teachers and students benefits on conducting the action research project, as well as their experiences as a researcher-practitioner. In this paper, only four teachers who responded fully to the open-ended questions have been reviewed and discussed. The participants are mathematics teachers with diverse teaching experiences: Egzon has three years of teaching experience in a non-public middle school; Isuf has ten years of teaching experience in a rural middle school; Qendresa and Besmir have five years of teaching experience in a secondary school.

As a lecturer for the action research course, I played the role of a facilitator helping the teachers carry out their own action research. The teachers' action research reports, my notes during class lectures, discussions, and the written responses to the open-ended questions used to conduct the research are presented in this paper. A qualitative content analysis research methodology (Cohen, Manion and Morrison, 2007) was used to identify major themes related to the three questions on the impact of the action research process: What are you and your students' benefits of doing an action

research study? What are some of your key experiences as a researcher? What advice would you give to colleagues about action research study?

Findings

All teachers inquired into different aspects of their teaching by defining research questions of relevance to their everyday situations, by collecting data, interpreting, drawing conclusions and writing down their findings in the research reports. The summaries of the action research projects, which are described below, are taken from the four teachers' reports.

The descriptions of teachers' action research reports

In his action research project, Egzon explains the reason why he was concerned with students' poor engagement in doing their homework in mathematics. As a mathematics teacher in a middle school, he had reviewed numerous sources about the importance and effect of performing homework, but he was more concerned about managing this process. In other words, he wanted to see if using the online platform would efficiently link the relationship between performing homework and observing or controlling their performance by students. Thus, in order to conduct his project on the online platform he involved the parents, strengthening the communication between parents, students and himself. Since the school where Egzon works is non-public and learning is conducted in English, he has been able to use the internet and other resources needed for the project. The engagement of Egzon in an action research project influenced not only an increase in the level of performance of the homework and the improvement of communication between parent, student and teacher but also the enhancement of quality in understanding the mathematics concepts and time management efficiency in carrying out the homework.

Isufi is another middle school mathematics teacher who works in a rural school. His concern was related to students' difficulties understanding fractions. Even though fractions are taught in primary education, according to the curriculum, in the sixth-grade students expand their understanding of fractions and continue learning fraction operations. As a mathematics teacher, Isufi was concerned with his student's preconceptions of fractions. Most students were confused about the concept of fractions, so he decided to explore more on teaching methods that could facilitate students' learning. He decided to use not only physical manipulatives but also virtual manipulatives. Similar to many schools in Kosovo, the school where Isufi works deals with a lack of labs and not all teachers know English. However, he planned to use ten computers that the school had so that each student would have the opportunity to use them. Isuf expressed that using new methods in the class was a challenge for him, especially when resources are not in the native language. But it is worth trying when such an action raises the students' interest and improves their learning.

Isufi had hypothesised that teaching his students how to use manipulatives, both physical and virtual, would improve their understanding of the fractions concept. Thus, after he collected data from several action research projects, he found that nearly all of his students improved their knowledge of fractions.

How to motivate and encourage students to learn mathematics? was one of the questions that Qëndresa, a mathematics teacher in the secondary school, often asks herself. She was concerned that her students spent most of their time using smart phones on social networks, so she thought of exploring if their phones could be of use to learn mathematics. Thus, she decided to engage students with IXL's interactive mathematics platform and to systematically evaluate if the students can improve their results in solving quadratic inequalities. She engaged her 32 students to use the interactive platform for the period of a month. The students were enthusiastic and curious to use the platform, she observed. Although it was challenging, Qëndresa noted a change in students' behaviors. After completing her research, Qëndresa concluded that:

Practising online tasks specifically of the IXL Math platform, makes all students active, more responsible problem solvers and more focused on tasks to cover the gaps and understand concepts by having fun and testing themselves.

Another action research study has been done by Besmir in secondary school. Unlike the previous action research studies, he put his effort into attempts to arrive at conceptual understandings of probability, which be considered problematic when students are asked to connect with everyday problems. Previously, Besmir reviewed the different studies in the field of probability teaching and was inspired by the findings of Zhonghe Wu's study *Using the MSA model to assess Chinese sixth graders' mathematics proficiency*. He adapted the MSA Model for his teaching of probability. His action research was based on quantitative data. He used a quasi-experimental design in order to assess the impact of the MSA model. For the intervention, he has developed learning plans based on the MSA model. This model shows the conceptual understanding, presenting a strategy that demonstrates the procedural steps for problem-solving and application or creating a similar word problem in a realistic situation. For implementing his study, he has separated all students into two groups, experimental and control group. In the experimental group, the teaching was based on the MSA model, whereas in the control group it was with traditional methods. A t-test analysis of scores from pre- and post-tests indicated that the experimental group performed significantly better than the control group.

The teacher's perceptions on the action research process

All of the teachers have shown that the benefits of an action research study were numerous. Some benefits mentioned by the teachers were related to the innovations in their teaching and their commitment to using various resources to improve the performance of their students. Below, are some of the thoughts shared by the participants:

The action research conducted in my classroom was a new experience for me, it was quite challenging. First, I had to analyze many research studies that have treated the same problem. I had to examine not only the theory that we have learned in other courses but also the different practices of teachers which helped me to improve the pedagogical aspect of my teaching and also to strengthen the academic components. (Besmir)

Teachers had observed that the carrying out of their action research projects in their classes increased the engagement of the students as well. The use of class activities that were not used earlier in the classrooms was one of the factors that stimulated students to be more active in mathematics class.

Self-confidence, passion for math, dealing with success and failure, accepting similarities and differences in problem-solving methods, giving and receiving help in group work were some of their characteristics that I didn't notice before. (Qëndresa)

My experience with action research had two effects. First, it has changed my habits and the second, I have changed my expectations for my students. I see action research as a stimulus not only for changing my teaching but also as a stimulus for students' engagement in the learning process. (Egzon)

Action research is a methodology that also helps us as teachers to turn the attention to ourselves, to understand our teaching methods, to find out what would be the best way to present different mathematical concepts to students, to measure our knowledge and supplement them if needed. (Besmir)

As a result of doing action research, teachers also shared some key experiences. The problems that arise in classrooms are often overlooked. For them, action research has increased their responsibility to deal more in detail with students' needs. Through action research, the teachers gained a lot of information during their literature reviews. The literature review has helped them find models and examples, which were later used in their teaching, practicing the new pedagogical methods. However, because there is limited research in mathematics education in the Albanian language, for some of them using the resources in English was a bit challenging. Thus, an important impact of the action research studies was not only to supplement gaps in the teachers' pedagogical knowledge and subject knowledge but, also to practice and improve their English.

Action research can be considered as a tool to make changes in our classrooms. Each step we make towards a change by adapting to today's time and student preferences can be successful. Therefore, I recommend all math teachers to consider action research as the method that gives them the answer every time they have a dilemma to reach out to their goals. (Isuf)

In addition to the benefits, the teachers have also presented some of the difficulties during the action research process. Difficulties in access to relevant documents, the understanding of the English language during the literature review, the data analysis and the limited time to complete the research by the end of the semester.

As I found it harder during the research process, I had a look at the literature. Lack of access to academic sites, or the cost of access to documents or relevant literature has been the most difficult part of the research. (Egzon)

However, due to the many benefits, they proposed that action research studies be a compulsory course for all preservice teachers, as well as a professional development program for all in-service teachers.

Discussion and conclusion

This paper aimed to explore how teachers formulate their own research problems and conduct their action research projects. Also, this paper examined the teacher's perceptions of their experience when they carry out action research as novice researchers. From the action research reports and the teacher's perceptions, it has been shown that there were different topics to which teachers oriented

their research, but all of them were concerned about the effectiveness of their ‘new teaching activities’ and their impact on students’ outcomes. The teachers’ reports on the impact of their action research show that these are consistent with other studies on how action research contributes positively to their development and professional autonomy by improving their teaching and increasing the students learning (Cohran-Smith & Lytle, 1993; Krainer & Zehetmeier, 2013).

The cases presented by teachers in this paper confirmed the finding from Capobianco and Ní Ríordáin (2015) that although their efficacy as mathematics teachers is sometimes difficult, through action research, difficulties can be recognized, accepted, and addressed in a positive and productive manner. The case of Egzon indicates that action research helped him to look for new ways of collaboration with parents and students in order to improve students’ engagement in doing homework. Isuf and Qëndresa indicate that action research encourages teachers to use technology in their class even when it is challenging for them. On the other hand, the case of Besmir shows that action research encourages him to analyze different sources, to examine the literature related to his field of interest and stimulates him to experience new methods in his classrooms that for others have been successful.

Teachers’ experience with action research has shown that they are able to do research in their classrooms successfully and that they can achieve remarkable results when the opportunities are given, especially if they are supported by the university teachers. Action research provides more opportunities for them to be responsible for improving their basic content knowledge, as well as for gaining knowledge and skills in research methods and applications (Altrichter et al., 1993; Loucks-Horsley et al., 2012). Thus, including action research in the study programs for teacher training for both preservice and in-service teachers will help them to create trust as an important conducive factor for generating new ways for learning (Krainer & Zehetmeier, 2013).

Action research in Kosovo can be approached as a potent methodology for educational reform. Action research engages teachers to investigate and teach through analyzing deeply the content and pedagogical issues needed for their teaching. Furthermore, action research challenges teachers to carry out changes, which are necessary for the implementation of mathematics curricula for pre-university education and to align them with international standards. Thus, universities need to consider including action research as a core unit in all teacher preparation degree programs (Hine, 2013) and stimulate collaboration with their students, in-service teachers, and schools, in order to conduct action research studies in mathematics classes as well as in all other subjects.

We started as a small-scale effort involving a few teachers to conduct research in their classrooms aiming to grow into an important part of school-based professional development. The effort for a university-led reform movement (Somekh & Zeichner, 2009), supported by the government as a national initiative, could be a possibility for fostering mathematics education. Ultimately, as cited by Krainer and Zehetmeier (2013), teachers should be key stakeholders in innovation and research, as well as in all educational reforms. This paper suggests that such an effort to prepare teachers to take the role of teacher-researchers is one of the possibilities to answer their concerns about teaching and learning in mathematics.

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