PROFESSIONAL DEVELOPMENT SCHOOL AS A CATALYST FOR IN-SERVICE TEACHERS' INTEGRATION OF ICT

Wajeeh Daher[1,2] Nimer Baya'a[1] Rawan Anabousy[1]

[1]Alqasemi Academic College of Education [2]An-Najah National University

ABSTRACT

The professional development school (PDS) can be a catalyst for the professional development of mathematics pre-service as well as in-service teachers. In the present research we describe lower-secondary in-service mathematics teachers' development of ICT integration in their teaching. This is done through the innovation diffusion model, where technology integration in mathematics teaching is considered as an innovation candidate for adoption by mathematics in-service teachers. The research findings indicate that the PDS can support the in-service mathematics teachers in their adoption of new innovations, specifically when this innovation is practiced by the pre-service teachers in the training school.

INTRODUCTION

The integration of ICT has been a key component of the agenda of teachers' professional development, where this agenda is influenced by three elements overlapping with each other to facilitate the use of ICT within schools (Mumtaz, 2000). These elements are: institutions, resources, and teachers, where the main barrier preventing the implementation of technology in education is teachers' beliefs and attitudes toward the role of technology, and towards the ability of successfully implementing it within schools (Magen-Nagar & Peled, 2013). Thus it is important to examine teachers' beliefs towards the integration of ICT in their teaching as a first step towards leading them to integrate ICT in the classroom. As supervisors of mathematics pre-service teachers in the training schools, we consider it our role to encourage the integration of ICT in teaching among the mentoring mathematics teachers in the training schools. This role is founded on our convection that ICT contributes to students' production of mathematical knowledge through supporting them in their mathematical investigations (Kreijns et al., 2013). In the current research we describe, utilizing the innovation diffusion model developed by Rogers (2003), the development of five mentoring mathematics teachers' beliefs and behaviors regarding the integration of ICT in their teaching in a professional development school (PDS). For us, a PDS is a school in which pre-service teachers, their school mentors and their college supervisors try to professionally develop together.

Innovation diffusion model

Innovation diffusion is the process by which innovation is communicated among the members of a social system through certain channels over time (Rogers, 2003). Moreover, the innovation-decision process is an activity in which information is sought and processed. In this activity, an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation (Sahin, 2006). Moreover, according to Rogers (2003), the innovation diffusion process passes over time through five stages (1) knowledge of an innovation, (2) forming an attitude toward the innovation,

(3) taking a decision to adopt or reject, (4) implementation of the new idea, and (5) confirmation of the decision by affirming or rejecting it. In the present research, we intend to examine, using Rogers' model of innovation diffusion, the development of ICT integration by in-service mathematics teachers working in a PDS.

RESEARCH METHODOLOGY

In the present research, we report the development of the integration of ICT by five lower-secondary in-service mathematics teachers in a professional development school (PDS) as a result of their mentoring of mathematics pre-service teachers in the academic year 2013-2014.

Data collection tools

We used a semi-structured interview to collect data about the participating in-service teachers' beliefs and knowledge regarding the ICT integration in mathematics teaching at the beginning and end of the academic year. At the same time, we used observations to assess their actual integration.

Data analysis tools

To analyze the data, we used the innovation diffusion model (Rogers, 2003) in order to categorize the in-service teachers' beliefs and practices of the integration of ICT into mathematics teaching. Doing so, we identified factors that could affect the innovation diffusion in each stage regarding the in-service teachers' use of ICT in teaching mathematics. These stages were: knowledge (when the participants learned about ICT use in mathematics teaching), persuasion (when they were persuaded of the value of ICT use in mathematics teaching), decision (when they decided to adopt ICT use), implementation (when actually integrating ICT in the classroom), and confirmation (when the integration was affirmed).

FINDINGS

We present the in-service teachers' knowledge, experience, obstacles and beliefs at the beginning of the academic year, then the other stages and then we present again their knowledge, experience, obstacles and beliefs at the end of the academic year.

At the beginning of the initiative, we, as supervisors of pre-service teachers in a PDS, faced some difficulties and obstacles convincing the mentoring teachers to integrate technology in mathematics teaching. One reason for the existence of these difficulties is the moderate knowledge possessed by the participating teachers in ICT. In more detail, the participating teachers reported that generally they are acquainted with some Office programs, like Word and PowerPoint, and with the Internet. The difficulties and obstacles were due also to the little experience of the participating teachers in integrating ICT in their mathematics teaching. For example one teacher reported using ICT for one year, while another teacher reported using only presentations and online games.

Together with the moderate knowledge in ICT and the little experience of the participating teachers in integrating ICT in their mathematics teaching, they were confronting different types of obstacles that discouraged them from integrating ICT in the classroom. These obstacles were of the types: Logistic obstacles (Insufficient infrastructure, students' density in the classroom, insufficient number of lessons), technology knowledge obstacles (fear to use technological tools), and technological pedagogical content knowledge obstacles (need for pedagogical support in integrating technology).

In spite of the participating teachers' little experience in integrating ICT in their teaching and the obstacles they confronted and discouraged them to integrate ICT in the classroom, the participating teachers had positive beliefs about the ICT integration in mathematics teaching. These positive beliefs were expressed through talking about the advantages of ICT integration in mathematics teaching: Advantages related to the learning materials (Connecting mathematics with real life phenomena, embodiment of mathematical concepts), advantages related to the learner (contribution to the learner's cognitive skills, contribution to the learner's technical skills, bridging the gap between students), and advantages related to the teacher (contribution to the material coverage, explaining the content).

These mentoring teachers' beliefs about the use of technology in the mathematics classroom were probably due to the general atmosphere regarding the importance of technology in education, and to their preparation as pre-service teachers. In spite of the participating teachers' positive beliefs, they were reluctant to integrate technology in mathematics education due, as mentioned before, to their little experience to do so and to the obstacles of different types that they were confronting in doing so.

Persuasion, decision and adoption

The five participating teachers agreed to mentor the pre-service teachers in their attempt to integrate ICT in their teaching. Nevertheless, they were afraid to integrate by themselves ICT in their teaching. We guaranteed the collaboration of our pre-service teachers with them and promised to accompany them in their integration of ICT in their teaching. This made them more convinced to accompany our pre-service teachers in their integration of ICT in mathematics teaching; what resulted in their decision to participate in the experiment. It could be said that all the participating teachers adopted our initiative, but in different levels.

Implementation: Knowledge, experience and obstacles

The mentoring teachers reported that their experience of accompanying the pre-service teachers in integrating technology in teaching mathematics added to their knowledge regarding technology itself, as well as its integration, and encouraged them themselves to integrate technology into their own teaching. This accompanying, they said, made their integration of technology into their own teaching easier and enjoyable. More specifically, three domains of pre-service teachers' assistance were pointed at by the mentoring teachers: technical assistance, technological pedagogical content assistance, and affective assistance. In addition, the mentoring teachers' experiences also included tackling logistic and technical obstacles while integrating technology in their teaching, but they looked at these obstacles as a natural part of engaging with ICT in teaching.

Confirmation: in-service teachers beliefs and intentions at the end of the academic year

At the end of the experiment, the mentoring teachers had the same positive beliefs about integrating technology in the mathematics classroom, but now these beliefs seemed to be founded on their experiences and not only on their previous studies and the general atmosphere regarding the importance of ICT in education, especially mathematics eduction. Moreover, the mentoring teachers became more knowledgeable regarding what to do with ICT in the mathematics lessons.

Regarding their intentions to use ICT in their teaching, the mentoring teachers expressed their intention to integrate ICT in their future teaching of mathematics, but as an additional tool in the mathematics classroom, and not all the time. For example one mentoring teacher said that GeoGebra is best for students to investigate mathematical relations, but the pencil and paper are needed for the students to assimilate and improve their procedural and formal mathematical skills.

DISCUSSION

Being part of a PDS, the participating in-service mathematics teachers substantiated with evidence their starting beliefs regarding the integration of technology in the mathematics classroom. The pre-service teachers' initiatives and experiences in teaching mathematics with ICT constituted the first phase of this evidence witnessed by the in-service teachers, but soon the evidence came from the in-service teachers' own experiences of integrating ICT in their mathematics teaching. The development of the in-service mathematics teachers' beliefs and practices regarding the integration of ICT in their teaching would probably not happened without the PDS, for it helped create a community of teaching professionals that encouraged certain teaching behaviors (integrating ICT in mathematics teaching and learning) and substantiated beliefs regarding these behaviors. The PDS was optimal for the in-service teachers to substantiate their positive beliefs about the integration of ICT in their teaching. This is due to the fact that in this context, it is possible for the in-service teachers to experiment teaching behaviors, and thus decide whether to adopt these behaviors or not.

This positive influence of the PDS on the educational scene is described by researchers; for example by Cave and Brown (2010) regarding the positive influence on students' achievement, and by Boote (2014) regarding the positive influence on mathematics pre-service teachers' emerging pedagogical content knowledge. The present research found that the PDS has positive influence on mathematics in-service teachers' practices; specifically on their adoption of new innovations.

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