Conference Book

EDUCATING THE EDUCATORS

2nd conference on international approaches to scaling-up professional development in maths and science education

7-8 November 2016
Freiburg, Germany

www.mascil-project.eu

University of Education Freiburg 2016

The mascil project has received funding from the European Union´s Seventh Framework Programme for research. Technological development and demonstration under grant agreement no 320693. This publication reflects only the authors' views and the European Union is not liable for any use that may be made of the contributions contained herein.

participants. Although none of the teachers wrote this, we were able to see from some of the responses that misunderstandings of the text did occur.
How can this material be used in the future by the teachers in their practice? Although we did not ask the teachers this question, one teacher wrote on the second questionnaire that "the lesson analysis will help me greatly in the future to plan my lessons better." Another teacher wrote, "I pictured myself in place of the teacher and asked myself what I would have done." These types of responses were repeated by many teachers from all backgrounds. In other words, one of the ways that this case material may be used in the future by the participants is by serving as an example of how classroom situations can be analysed.
While teacher educators call for cooperation between participants and the establishment of teacher learning communities (e.g., Jaworski 2008), it can be quite demanding and challenging. In our course, we attempted to engage all participants by having them analyse a case which came not from their own classes. While results indicated that most participants were engaged with the materials, it is unclear how a program with such a diverse population can be scaled up. One way could be at the school level, whereby each participant becomes a potential multiplier and uses the case materials for staff development. In the future, participants could use this case material as an example of how to develop cases from their own classroom situations to discuss at staff meetings. We look forward to discussing these possibilities with participants at the conference.

Triantafillou, C. (ASPETE, Greece), Psycharis, G. (National and Kapodistrian University of Athens), Potari, D. (National and Kapodistrian University of Athens), Zachariades, T. (National and Kapodistrian University of Athens), Spiliotopoulou, V. (ASPETE, Greece) — Research-based presentation on material dimension

Aspects of secondary teachers' attempts to integrate workplace in teaching'

Tuesday, 10:50-11:20, Room KA 101

1. The focus of the study
The present study aims to examine how practicing mathematics teachers integrate workplace tools and practices when designing and implementing problem-solving classroom activities and what are the main factors that facilitate or constrain this integration. The study took place in the context of a European project, mascil (see: www.mascil-project.eu), that aims to integrate workplace in the teaching and learning of mathematics and science through implementation of inquiry-based tasks in classrooms. It draws evidence from the project implementation in Greece and more specifically from the professional development (PD) phase. How teachers can use the workplace as a context for designing and using lesson activities in the classroom remains an open question that has only received partial answers from small scale studies mostly on prospective teachers. Nicol (2002) found that a teacher education program including visits to workplace sites helped prospective teachers to keep the mathematics contextualized when designing activities for their students. Frykholm and Glasson (2005) suggested that teacher education courses involving collaboration between science and mathematics prospective teachers provide a fertile ground for them to develop interdisciplinary units connecting both topics. Moreover, school science and mathematics communication can be empowered by lesson designing on the basis of workplace (Shirley et. al. 2011). Particularly, we examine how practicing science and mathematics teachers are involved in integrating workplace tools and practices in their classroom teaching and what factors facilitate or hinder this integration. In the analysis, we adopted Engeström's (2001) model of interacting activity systems. We considered two activity systems, the activity of workplace and the activity of mathematics teaching in which the teachers have been engaged, in order to study the interaction between the two.

2. The context of the study and methodological issues

In mascil implementation in Greece, thirteen groups of practicing secondary teachers (about 10 in each group) from mathematics, science and technology have been established to work in the spirit of lesson study. In each group, teachers collaborated with the support of a teacher educator for a school year to design and implement inquiry-based tasks related to workplace non-routine situations and reflect on their teaching. Before and after each implementation of the designed lessons PD meetings took place. In this study, we focus on five groups of practicing teachers (22 mathematics teachers, 14 science and 9 technology) working in upper or lower secondary school with long teaching experience (more than ten years). We analyze the work of the mathematics and science teachers, who collaborated together as well as with technology teachers in their groups during the PD courses. The analysis of different cases of teachers indicated different ways of interaction among the elements of the activity systems. In this paper, we present the case study of one mathematics teacher based on video recordings of her classroom implementation, her own portfolio and audio recordings of the discussions in the PD meetings. This case shows a strong integration of workplace into mathematics teaching.

3. Findings

In the analysis of the different cases, we tried to identify what are the aspects of a successful path in teachers' design and implementation during teachers' collaboration in the PD course. We will focus on a good example that will be discussed analytically. It refers to a mathematics teacher, Katerina, with about 10 years of teaching experience. She participated in a mascil group with 13 members (eight mathematics, one technology and four science teachers). Katerina developed a task entitled "Seismologists for one day", where the students had the role of a seismologist responsible to study main features of a specific earthquake (e.g. the epicenter). The initial idea of the task was provided by a group member whose specialization was geology. The PD educator suggested collaboration between mathematics and science teachers as a way to integrate workplace context into classroom teaching. The geology teacher designed and implemented the task in his classroom and shared his materials (e.g., description of the main features of this physical phenomenon and how they are studied by specialists) with the PD group. Katerina was teaching mathematics and geography in grade 7 in her school, so she found as a challenge to develop a task for integrating the context of seismologists into her teaching by combining mathematics and geography. Her familiarization with the context of earthquakes in the PD meetings allowed her to identify that it was possible to design such a task for her students. In classroom implementation, Katerina presented and discussed scientific aspects of the earthquakes from physics and geography and provided students with authentic data from the National Institute of Geodynamics. The data included (a) the velocity of p (VP) and s (VS) waves and the exact time these waves were recorded in specific seismic stations, as well as the mathematical formula $D = \Delta t \cdot (VP \cdot VS) / (VP - VS)$ (1) which indicates the distance D in Km of the epicenter from the seismic station; (b) a geographical map indicating all the seismic stations in the country with the corresponding codes (e.g., LKD2 for the seismic station in Lefkada island); and (c) the specific measures recorded in the seismographs of six stations in west Greece (Figure 1). In terms of mathematics, the students had to identify that the epicenter of the earthquake was the common point of three intersecting circles whose centers were situated on three seismic stations (Figure 2). In particular, they had to: substitute given quantities into the formula (1), to calculate the distance of the epicenter
from the different stations; model the situation through the use of map scales; conceptualize the calculated distances as radii of different circles; and design them with the use of ruler and compass.

Sta	Dist (km)	Phase	Time	Amp (micrometers)
LKD2	77.60	P_0	14:22:38.011	
LKD2	77.60	AML	14:22:57.030	33484.0
LKD2	77.60	AML	14:22:55.740	25412.6
PDO	82.00	P_0	14:22:39.117	
PDO	82.00	AML	14:23:00.010	53468.1
PDO	82.00	AML	14:22:59.040	71045.4
RLS	85.90	P_0	14:22:40.039	
RLS	85.90	AML	14:22:57.300	25157.1
RLS	85.90	AML	14:22:56.550	28409.4

Figure 1. Data sheet from seismic stations

Figure 2. Students' actions as seismologists

Katerina's attempt to integrate the workplace of seismology into her teaching was followed by a number of actions such as (a) her own familiarization with the workplace context through discussions with the geology teacher in the PD group and her involvement in teaching mathematics and geography in the same classes, (b) her decision to connect the topic of earthquakes included in the geography curriculum with aspects of the mathematics curriculum (e.g., scales, properties of geometrical figures), (c) the use of authentic workplace worksheets and tools and (d) the assignment of the role of a professional to the students simulating the actual workplace practice. In the case of Katerina, we see that the two activity systems are strongly connected forming and a new object started to be formulated in the intersection of the two systems. In this case, sharing of artefacts, goals and actions between by mathematics teaching and workplace appeared through the simulation of the workplace activity in the classroom.

4. Conclusions

The presented case study indicates the nature of interaction between the activity system of workplace and the one of science and mathematics teaching. We address these forms of interaction by focusing on two dimensions: the process by which the teacher attempted to integrate workplace into her teaching and the factors that supported this integration. As regards the process of integration, we notice teacher's attitude in terms of familiarizing herself with the workplace context and her actions in terms of engaging students in modelling activities, familiarizing them with the corresponding professional contexts and assigning them a professional role and task. Modelling is a process that triggers teachers' interest and as Wake (2015) argues it operated as a means of building connections between mathematics teaching and workplace. This process was adopted by Katerina who engaged students in mathematizing workplace situations such as identifying geographical maps' scaling and viewing modelling embedded in a process of simulating authentic workplace practice in the classroom. Her students engaged in workplace working with authentic contextual or scientific representations such as diagrams of sun's route or geographical maps and assigned them a professional role (i.e. seismologist) and a task (i.e. to find the epicentre of an earthquake) strongly related to the workplace practice. On the other hand, her collaboration with teachers from different disciplines in the PD group in co-designing a task was definitely a supportive factor in constructing an activity through interaction between workplace and mathematics teaching activity systems. The initial idea of a geology teacher was the basis for Katerina to extend her experiences. Her teaching experiences of geography supported a smooth integration of the workplace practice of a seismologist in her classroom teaching of mathematics. Based on the existed material, she inquired further the rules of the workplace underlying mathematics teaching. This supports recent research findings that acknowledge workplace as a fertile ground for science and mathematics teachers' collaboration (Potari et. al. in press).