13th International Congress on Mathematical Education
Hamburg, 24-31 July 2016

ON THE DEVELOPMENT OF A COLLABORATIVE PARTNERSHIP MODEL INVOLVING IN-SERVICE TEACHERS AND RESEARCHERS

Salomé Martínez and Leonor Varas

Universidad de Chile Universidad de Chile

We report a collaborative partnership experience between in-service teachers and a team of researchers and professionals affiliated to a research center, which was established with the goal of producing video-based instructional resources focused on teaching practices for pre-service teaching training.

INTRODUCTION

Learning to teach mathematics is a highly complex process influenced by many factors (Llinares & Valls, 2009). Ball & Forzani (2011) state that identifying practices that are fundamental in supporting student learning is at the core of building an effective system for the professional training and development of teachers. Moreover, they propose to establish a common core of fundamental and professional knowledge as well as skills which should be present in any teacher training program focusing in the development of instructional practice. Several studies promote teaching practice as the core of pre-service teacher training. For instance, Boyd et al. (2009) present studies on the effects of teachers' preparation on teachers' value added to student test score performance. This concluded that preparation directly linked to practice appears to benefit teachers in their 1st year.

The decisions regarding how a teacher should be prepared are closely related with the ways in which teacher educators conceive teaching, as a professional practice (Forzani, 2014). In the recent efforts on the design of teacher education, focused in core practices, teaching is conceived as the management of interactions between the teacher and her knowledge, the students and their knowledge, and the content being taught. Therefore, teaching is the work that teachers do to help students learn, using the curriculum and their classmates as learning resources (Forzani, 2014).

In the Teaching Works project, high leverage practices which are the heart of the work of teaching and are most likely to affect student learning, are identified. Ball & Forzani (2011) propose that these practices could provide the foundation for teacher education. The development of teacher training programs surrounding teaching practice requires that future teachers have the opportunity to learn, observe, analyze, and enact these practices, recognizing key elements of them. For this purpose, the incorporation of classroom videos appears to be a useful instructional resource.

In this paper, we will report on an experience in partnership between in-service teachers and a team of researchers and professionals affiliated to a research center which engaged in activities such as lesson planning, video-feedback, video analysis and coaching. This partnership was established in the framework of the R+D project "Resources to strengthen the preparation to teach mathematics of pre-service teachers based on classroom experiences" (FONDEF 13I10005, 2014-2016) with the goal of producing video-based instructional resources (multimedia textbook). Also, as a part of the

project, professional development courses for in-service teachers and teacher educators were designed and implemented.

Use of videos for teacher training

The use of videos has played a prominent role in teacher training in the last 15 years. Videos provide opportunity to pre-service teachers to witness a wider range of teachers, students, contexts, teaching practices, and content than a typical field experience (Star & Strickland, 2008). The analysis of mathematics lessons through video provides pre-service and in-service teachers with experience in observing and interpreting, helping them to understand the teaching of mathematics (Llinares & Valls, 2009). Moreover, videos can be used to foster productive discussions regarding mathematics teaching and learning (Borko et al., 2008), providing meaningful learning opportunities since discussions are seen as a means to facilitate deep learning and to help students to develop their cognitive skills (Llinares & Valls, 2009). As stated in Bloomberg et al. (2013) and the references therein, pre-service teachers perceive video as a vivid second hand experience that captures the complexity of classroom situations and viewing teaching via video is quite motivational and compelling for pre-service teachers.

There are varied instructional purposes for the use of videos. For instance, videos can be used to acquire specific teaching techniques (Lemov, 2009). Video analysis can also be used to improve the ability to notice, that is identifying what is important or noteworthy about a classroom situation, of preservice teachers (Star & Strickland, 2008; Sherin & van Es, 2005; Llinares & Valls, 2009). The use of video can also support other learning goals such as the strengthening of teacher´s content, pedagogical content, and general pedagogical knowledge, developing reflective knowledge of teaching and learning (Blomberg et al., 2013; Rich & Hannafin, 2009).

We refer to the work of Blomberg et al. (2013) for an interesting review of empirical evidence regarding the use of videos in pre-service teacher education, and also research-based heuristics concerning how to think about and use video in order to create well-conceptualized learning environments.

Teacher training in Chile

Strengthening teacher training is currently one of the biggest focuses in Chilean education. There are persistent gaps in the performances of children and youth in standardized tests, where the performance of Chilean students is lower than in countries of similar development levels (OECD, 2014). While in the last few years there have been significant improvements in the performance in reading, results in mathematics have not progressed significantly.

There are several studies showing that Chilean elementary school teachers lack the necessary mathematical knowledge to teach. In the result of an evaluation of disciplinary and pedagogical knowledge applied to in-service teachers from grades 5 to 12 in Chile (Rodríguez et al., 2013), shows that teachers have procedural knowledge but are not able to integrate this into the teaching of several contents, this results in an application of knowledge in an unfamiliar context and use of unorthadox strategies that do not rely on standard content or procedures.

Also, there are significant deficiencies in teaching practices. Studies have concluded that the teaching of mathematics is teacher-centered, that in the lessons there is a predominance of questions

involving low cognitive demand, and that students do not actively engage in meaning making and reasoning (Araya & Dartnell, 2008; Radovic & Preiss, 2010).

Regarding professional development, it is reported in the TALIS 2013 report (OECD, 2014) that only 72% of Chilean teachers are reported to have participated in professional development programs in the year before the study v/s an OECD average of 88%. Among the main reasons they argue for not participating are: the lack of incentives (73.1% v/s 48%), that is too expensive or inaccessible (72.8% v/s 43.8%) and that the offer is not very relevant (63.6% v/s 39%).

In pre-service teacher training we are also facing important challenges. As it is shown in the TEDS-M report (Tatto et al., 2012), pre-service Chilean teachers were among the lowest performers in the Mathematical Knowledge and Mathematical Pedagogical Content Knowledge tests, both at the primary and lower-secondary levels. This is consistent with the lack of opportunities that pre-service teachers have to develop the mathematical knowledge for teaching (Chandía et al., 2013, Varas et al. 2008).

The good news is that today there is a national consensus on the need to strengthen the teaching profession. Currently, the parlament is discussing a new bill to promote the strenghtening of the teaching profession which addresses issues such as working conditions, in-service professional development and pre-service teaching training.

OBJECTIVE

To develop a model of collaborative work, between in-service teachers and a multidisciplinary team from a research institution, focused on the recognition of the complexity of the professional tasks involved in teaching mathematics

METHODOLOGY

To understand relevant aspects of the model developed we should explain the conditions for the elaborated resources. This consisted of a published multimedia textbook, containing activities centered on the analysis of video segments produced from mathematics lessons of the in-service teachers.

One important condition for the videos is that they should exemplify good teaching practices, concerning mathematical content and classroom interaction. This fact inadvertently puts a strain on the collaboration with teachers, as this invariably involves judgment on the quality of the recorded lesson. Thus, the collaboration was challenging and involved not only direct observation and analyses of lessons. It also required the need to ask teachers to carry out a lesson which showed both, a specific teaching practice and promoted the development of teaching skills. Thus, one of the key principles in the methodology for developing this working partnership was to highlight, within the team, that exemplary practices will occur in real classes, which are subject to many imperfections. This practice was incorporated during the first stage of working with the teachers.

The development of the video-based instructional and collaborative work resources involved mainly two processes: 1) Work with pre-service teachers and production of videos; 2) Development of the resources.

Participants

The project involved joint collaboration between a developing team, composed of researchers and professionals (psychologists and math teachers), and 15 in-service teachers whose classes were recorded and analyzed to produce the videos and supporting activities.

The developing team was composed of researchers, including mathematicians with extensive experience in math education projects and math education experts, psychologists and math teachers. Most of them were K-3 Certified CLASS observers (Pianta et al., 2008) and had experience with the MQI classroom observation protocol (Hill et al. 2008). Part of the team had extensive experience as instructors of professional development programs for elementary school teachers and/or instructors of math methodology courses for pre-service elementary school teachers.

The in-service teachers participating in the project had varied teaching experience, and, during 2014, they taught math from 1st to 6th grade (covering all except for 2nd grade). We included teachers according to the requirements of the project, such as showing a variety of types of school (private, public, semi-private) located in counties with different SES. Some of the in-service teachers were contacted directly while in other cases we contacted the schools. Some of the participating teachers had experiences with projects that involved video recording lessons.

Development of video based resources

We describe some key features of the processes involved in the development of the video based resources.

Work with pre-service teachers and production of videos

Before arriving at the refined definite recorded lessons, we worked for several months with the in-service teachers involving: recording of one lesson, a three week workshop focused on promotion of interactions in the classroom, video feedback of the lesson, planning, and production of a professional video. The first lesson was recorded to recognize exemplary teaching practices on all participants, and also to detect aspects of their teaching that needed improvement. We were aware that most of the classes may have only a few good segments. From the analysis of this lesson, we concluded that most of the participating teachers needed to improve aspects of their practice related to the richness of the mathematics being offered to the students, as well as instructional support and student engagement, while in a few lessons we could see that behavioral management and/or classroom climate were issues that needed to be addressed.

The workshop was developed to provide teachers the opportunity to observe, analyse and perform teaching practices related to the aspects mentioned above, and was attended not only by the participating in-service teachers but by all teachers at their corresponding schools. One important objective of the workshop was to make teachers aware of their own habitual teaching practices, which we presented through segments of their recorded lesson. These practices were analyzed all together and validated using specialized literature. This action helped improve teacher's self-esteem and the will to continue collaborating in the project with the expectation of making a valued contribution.

Following this workshop, we provided video-feedback to each of the participating teachers, and the lessons to be recorded professionally (for use in the multimedia resources) were jointly planned by

the in-service teacher and one teacher from the developing team. The decisions regarding the particular lesson, such as content and activities, were made in most cases by the in-service teacher, but we negotiated the date of the lesson in order to guarantee a variety of subjects portraited in the videos (numbers, algebra, geometry, data, and probability). The recorded lesson was not rehearsed.

We worked with two of the participating teachers during 3 months in 2015 through a coaching strategy, with the purpose of implementing whole class discussions following the approach described in Chapin et al. (2013). Within this time we recorded professionally two additional lessons of each teacher.

Development of the resources

The purpose of the textbook was to promote the analysis of teaching practices, activate and also to promote the integration of mathematical and pedagogical content knowledge. To produce the material, each lesson was dissected into 3-8 segments showing specific teaching practices, for instance monitoring student's work, scaffolding, giving feedback, having classroom discussions, presenting tasks. In almost all the segments mathematical work is shown. Each segment has its own focus, for instance, demonstrate the way a teacher remediates a pupil's error, or the way a pupil provides an explanation for the procedure they used to solve a problem. The activities aimed to facilitate the analysis of the video through three perspectives: richness of the mathematics, student participation in reasoning and meaning making, and promotion of learning. Some activities of the book were designed to be discussed collectively.

The multimedia textbook was developed in two stages. In the first stage, during 2014, preliminary material was developed using the basis of approximately 10 videos, with the aim of using it in a piloting process, as an instructional resource for math related courses of Elementary Education Teacher programs to assess the relevance, format and usability of the material. Indeed, the material was used in approximately 30 different sections of 15 programs, involving close to 30 teacher educators and 1000 pre-service teachers. In this stage, the segment selection and the activities were created by the developing team, taking into consideration the CLASS and MQI protocols. The second stage of development was carried after the piloting process. All the video segments and activities developed in the first stage were revised, and somewhere in the range of 10 more videos were processed. The principal positive objectives of the piloting process was to define duration of between 3-8 minutes, simplify the activities in order to make their focus more evident, and include more math related activities, such as: the proposition of different strategies in task solving, anticipating pupil's errors, etc. In Fig. 1 an example of activity is shown.

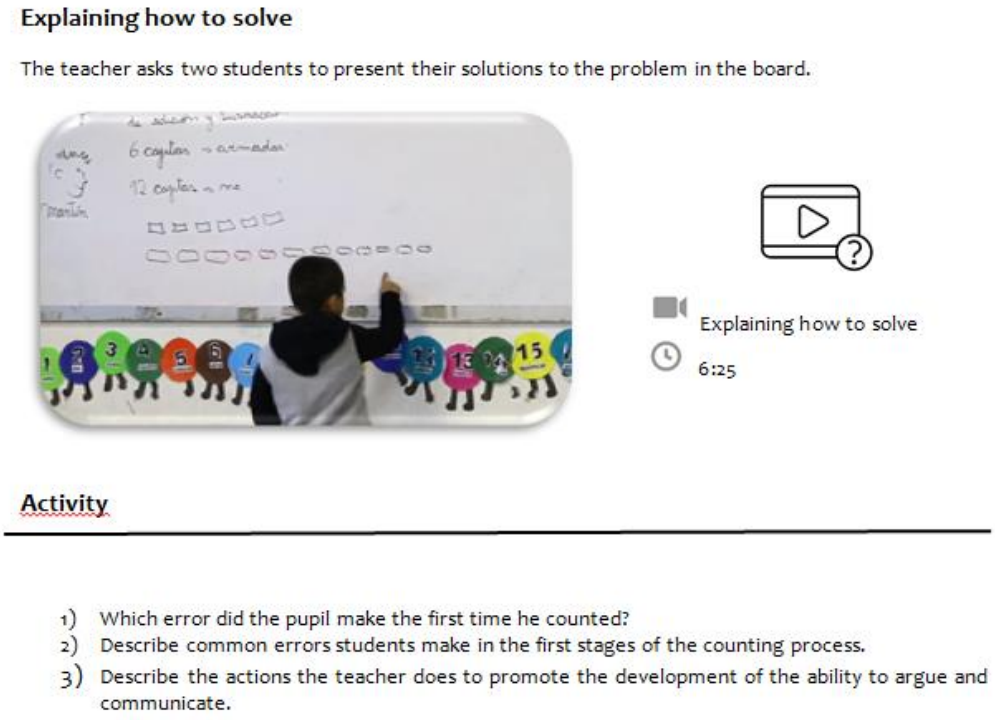

Fig 1: Example of an activity

CONCLUSIONS

According to Oliver (2005), some of the benefits of the engagement of teachers on school based research are: being encouraged to try different ways of teaching; being supported to try new challenges; receiving opportunities for self-reflection, critical examination of practice, ongoing support and mentoring to change; enjoying the collegiality provided through partnership with other teachers. These findings also hold for our project. Participating teachers reported to be more aware of their own teaching practices and the value of their expertise. They also valued the oportunity to share their practical knowledge with colleagues and future teachers, and reported that incorporation of teaching strategies to increase pupil's participation, had been beneficial for them and their students. Some of these changes were observable from the recorded lessons. Many of the participating teachers were surprised that we had highlighted their good teaching practices as a starting point for our work, instead of the *bad* ones.

There were some important issues that facilitated the collaboration. First, teachers were involved in the earlier stages of the project and they participated actively in many important decisions of the project. The content and instructional format of the lessons portrayed in our video based resources were decided on the most part by them. The teachers recognized early, the fundamental value of their contribution in our project and that the researchers can learn from their experience.

Other important issue that facilitated collaboration was the participation of math teachers in the research team. These teachers participated in all stages of the project, in particular giving feedback, attending recorded lessons, and working alongside the in-service teachers in lesson planning. To share the same professional language and experience was key in the success of these tasks. These math teachers also worked in the selection of segments and the design of the activities. Their

knowledge of the teachers and their classrooms was very important for the development of resources also.

Finally, the decision on working with the teachers having as a starting point their strengths, instead of their weaknesses, to state that we recognize that teaching is a complex task where many unpredictable things can happen, and to agree at an early stage that exemplary practices can be found in any class, was crucial. Even though all these facts are easy to agree with, in the project they translated into concrete actions.

Acknowledgements

Funding from FONDEF IT 13I10005, PIA-Conicyt Basal Funds for Centers of Excellence Project BF0003, Basal project CMM U. de Chile and UMI2807 CNRS are gratefully acknowledged.

References

Araya, R., & Dartnell, P. (2008). Video study of mathematics teaching in Chile. In *Proceedings of the 11th International Conference on Mathematics Education Conference*.

Ball, D.L., & Forzani, F. (2011). Building a common core for learning to teach and connecting professional learning to practice. *American Educator*, 35(2), 17-21, 38-39.

Blomberg, G., Renkl, A., Sherin, M. G., Borko, H., & Seidel, T. (2013). Five research-based heuristics for using video in pre-service teacher education. *Journal for educational research online*, 5(1), 90-114.

Borko, H., Jacobs, J., Eiteljorg, E., & Pittman, M. E. (2008). Video as a tool for fostering productive discussions in mathematics professional development. *Teaching and teacher education*, 24(2), 417-436.

Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J. (2009). Teacher Preparation and Student Achievement. *Educational Evaluation and Policy Analysis*, 31(4), 416-440.

Chandía, E., Reyes, C., & Martínez, M. (2013). Descripción de las prácticas de los formadores de profesores de Educación Básica en Matemática. Technical Report CMM-B-13/04-242 2013.

Chapin, S., O'Connor, & C., Canavan, N. (2013). *Classroom discussions in math: A teacher's guide for using talk moves to support the common core and more, grades K-6*. 3rd Edition. Math Solutions Publications.

Forzani, F. M. (2014). Understanding "Core Practices" and "Practice-Based" teacher education learning from the past. *Journal of Teacher Education*, *65*(4), 357-368.

Hill, H.C., Blunk, M., Charalambous, C., Lewis, J., Phelps, G.C., Sleep, L., & Ball, D.L. (2008). *Mathematical Knowledge for Teaching and the Mathematical Quality of Instruction: An exploratory study*. Cognition and Instruction, 26, 430-511.

Lemov, D. (2009). *Teach Like a Champion: 49 Techniques that Put Students on the Path to College*. First edition. Jossey-Bass.

Llinares, S., & Valls, J. (2009). The building of pre-service primary teachers' knowledge of mathematics teaching: interaction and online video case studies. *Instructional Science*, *37*(3), 247-271.

OECD (2014). TALIS 2013: An International Perspective on Teaching and Learning. OECD Publishing.

Oliver, A. (2005). *The TLRI: Teachers' perspectives on partnership and research*. Wellington: New Zealand Council for Educational Research.

Pianta, R. C., LaParo, K. M., & Hamre, B. K. (2008). *Classroom Assessment Scoring System (CLASS) Pre-K Version*. Baltimore, MD: Brookes Publishing.

Radovic, D., & Preiss, D. (2010). Patrones de discurso observados en el aula de matemática de segundo ciclo básico en Chile. *Psykhe (Santiago)*, *19*(2), 65-79.

Rich, P. J., & Hannafin, M. (2009). Video annotation tools technologies to scaffold, structure, and transform teacher reflection. *Journal of Teacher Education*, *60*(1), 52-67.

Rodríguez, M., Carreño, X., Muñoz, V., Ochsenius, H., Mahías, P., & Bosch, A. (2013). *¿Cuánto saben de matemática los docentes que la enseñan y cómo se relaciona ese saber con sus prácticas de enseñanza?* FONIDE Technical Report.

Sherin, M. G., & van Es, E. A. (2005). Using video to support teachers' ability to notice classroom interactions. *Journal of technology and teacher education*, 13(3), 475-491.

Star, J. R., & Strickland, S. K. (2008). Learning to observe: Using video to improve preservice mathematics teachers' ability to notice. *Journal of mathematics teacher education*, 11(2), 107-125.

Tatto, M.T. et al. (2012). *Policy, practice and readiness to teach Primary and Secondary Mathematics in 17 countries: Findings from the IEA Teacher education and development study in Mathematics*. International association of the evaluation of educational achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands.

Varas, L., Felmer, P., Gálvez, G., Lewin, R., Martínez, C., Navarro, S., Ortiz, A. & Schwarze, G. (2008). Oportunidades de preparación para enseñar matemática de los futuros profesores de educación general básica. *Calidad en la Educación*, 29, 64-88.