

Teachers as Design-Researchers of Technology-Enhanced Learning

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Abstract

In this study we describe our Teachers as Design-Researchers approach for in-service teacher learning and professional development. Based on this approach we designed a series of three semester-long courses in order to support teachers in the process of (a) developing a technology-enhanced learning environment, (b) enacting it with learners, and (c) exploring its impact in various contexts. We studied the relevancy that teachers attributed to "design" and "design-research" with regard to their professional practice. Findings indicate that as teachers' progressed through the three courses a dramatic increase was found, with "design-research" evolving into a major construct in their professional identity.

Keywords: Teachers as Design-Researchers (TaDR), instructional design, design research.

Introduction

Non-thesis MA Programs are common in many universities around the world for academic studies that incorporate a strong practical emphasis. In such programs students are typically required to submit a final project report based on a small scale study they conduct autonomously, with little guidance. The current research studies the Teachers as Design-Researchers (TaDR) track, which we designed for a two-year (4 semesters) non-thesis program in a Technologies in Education department in a research university. The audience is typically in-service teachers, when the term "teachers" refers to a wide definition including not only K-12 environments, but also non-formal and industry settings. The final project in the TaDR track includes the design and development of a technology-enhanced learning (TEL) environment, and a small scale design study that explores the learning afforded by the environment.

To support teachers to reach this ambitious goal we designed a set of three successive semester-long TaDR courses, starting in the second semester of the program, which guide teachers throughout the process. In this paper we describe the rationale, theoretical underpinnings, and some preliminary findings from the first 3 cohorts of 54 teachers who participated in the TaDR track.

Theoretical Background

The explosion of information, immense developments of knowledge, and unpredictable changes that have characterized our society in the past decades, require professionals in many arenas, and especially the arena of education, to constantly learn, adopt and develop new knowledge and practices. Wallace and Loughran (2012) claim that "schools, more than most organizations, are in the business of learning, and that all members of the organization, administrators, support staff, teachers and students, should operate in an environment where learning is actively and explicitly valued and supported" (p. 295). Several approaches and models have been suggested

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and explored throughout the years to support in-service teachers in this everlasting task. Cochran-Smith and Fries (2008) interpret this variety of models as representing an evolutionary process in the way teacher professional development (TPD) has been viewed by the research community, from a curriculum stance in the first half of the 20th century, through a training stance in the second half, and a learning and policy stance nowadays.

A productive trajectory for supporting in-service teachers as learners, which builds on Schon's notion of the "reflective practitioner" (Schon, 1983), and the idea of "action research" (Elliott, 1991), has been to involve teachers in research regarding their own practices. This trajectory has gained renewed interest as information and communication technologies have increasingly found their way into many curriculum materials in various domains. TEL environments provide teachers with unique opportunities to explore their students' learning. These explorations can serve not only to improve their own teaching, but also to adapt the technologies, often designed by experts, to better support their students' learning, which altogether, have been shown to enhance student outcomes (Davis & Varma, 2008; Gerard et al., 2010; Linn & Eylon, 2011). In this manner, especially when the technology is designed to enable teacher customization, teachers become important players in the curriculum design endeavor.

Research has advocated the significant role that teachers play in multi-expertise curriculum design teams (Kali, Markauskaite, Goodyear, & Ward, 2010; Mishra & Koehler, 2005; Penuel, 2007), but nowadays, as free online tools that enable simple authoring (e.g. Google Apps) are becoming widespread, many teachers are expected to design their own learning materials (Shamir-Inbal, Dayan, & Kali, 2009). However, designing learning materials, and refining them according to evidence from student learning is a very complicated task, as Laurillard (2012) claims in her recently published book: "Teaching is a design science. Like other design professionals – architects, engineers, programmers – teachers have to work out creative and evidence-based ways of improving what they do" (abstract). In this study, we took upon ourselves the ambitious task of providing in-service teachers with the knowledge, skills and social infrastructure that would enable them to professionally act within this realm.

The Three TaDR Courses

All courses were conducted using a design studio approach (Hoadley & Kim, 2003; Kali & Ronen-Fuhrmann, 2011), in which learners accomplish much of the work during class meetings, while the role of the instructors (the authors of this paper) is to visit the teams at work, provide feedback, and encourage discussion within and between teams. For each of the courses we designed a platform (using Google-Apps), which provided the teachers with all the instructions for course activities, online resources, and knowledge-building work areas. In this manner we modeled the roles we sought that teachers will adopt: (a) teacher-as-mentor, and (b) teacher-as designer. In the second and third courses, as described below, we also modeled a third role; teacher-as researcher.

It is important to note that prior to the TaDR track, during their first semester in the Technologies in Education program, teachers are introduced with learning sciences theoretical foundations. The teaching is typically carried out in a socio-constructivist approach using TEL environments. Thus teachers already experience, as learners, the pedagogical approach we pursued.

Course 1 – TEL Design and Development

This course supported teachers in designing and developing a TEL environment for their own learners (about 8 two-hour sessions of learner interaction). Teachers were able to choose

whether learners will be their own students, other students, other teachers, or any group of people in their community. The course started with "a market of dreams" – each teacher was encouraged to reflect on her experience as an educator, and think of challenging situations which she thought technology might provide answers to. These ideas served as seeds for team projects whose participants continued to work together throughout the TaDR track. Teams provided feedback to each other along the different design and development stages (Kali & Ronen-Fuhrmann, 2011).

Course 2 – Enactment and Data Collection

This course accompanied the teachers while they enacted their learning environments with learners. In parallel to the enactment, the teachers started their role as researchers; we designed assignments that guided them to raise accountable research questions, plan and develop research tools, collect data regarding how learners are impacted by their intervention, and record their experience in a reflective journal. Activities included whole-class and group-sessions in which teams shared and received oral and written feedback regarding: (a) their enactment experiences (challenges as well as success stories), and (b) their current state regarding data collection.

Course 3 – Data Analysis and Academic Writing

This course assisted teachers in analyzing data they collected in the previous semester. Although teachers were required to study a research-methods course in the MA program they were part of, it was clear that in order to conduct their own research, further support is required. Therefore, we designed the course activities around two themes; a data analysis theme, and an academic writing theme.

In each course-meeting in the data analysis theme we illustrated how real data can be analyzed. Following each of these illustrations, teachers worked in teams to analyze their own data using the illustrated technique, and to upload their analysis to the website, so that all teachers will be able to learn from each other's work. The academic writing theme activities were conducted in parallel to the data analysis theme activities. From the beginning of the semester, the teachers were required to write chapters of the final project report regarding their research. We developed a set of guidelines to assist teachers in writing each chapter, and a template that helped them follow academic writing conventions. We also developed a peer feedback procedure in which each chapter was successively reviewed by three teachers. Following this first round of revisions, we – as course instructors – provided another round of feedback on each of the final project report chapters.

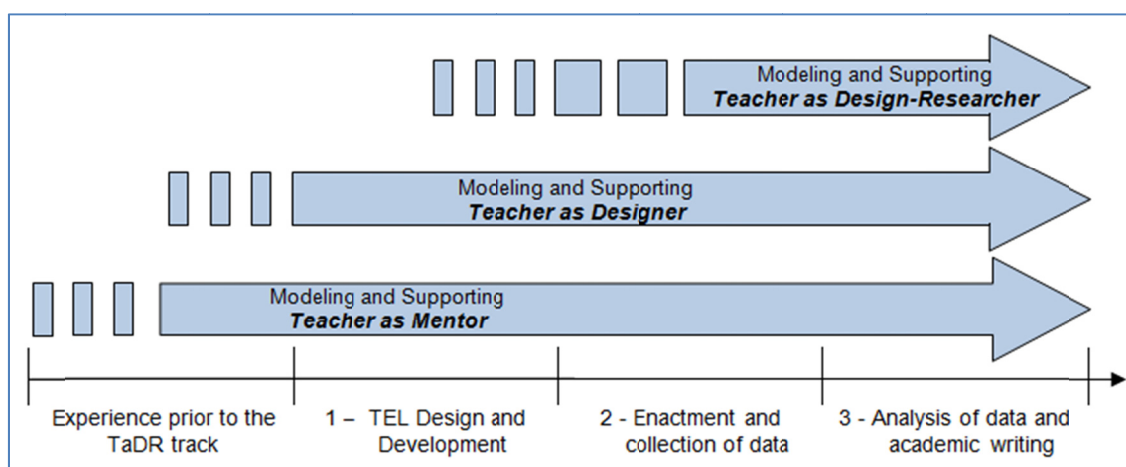


Figure 1. Modeling and gradually involving teachers in the three roles throughout the TaDR courses

Methods

This study is part of longitudinal research, still in-progress, which follows each year a new cohort of teachers along the two years of the program. Currently, two cohorts of teachers have completed the program and a third is in progress. Teachers complete a questionnaire at beginning and final stages of their studies (pre and post). The questionnaire consists of 17 Likert type and one open-ended question regarding the relevancy of various constructs to TPD. Table 1 shows the data which provided the source for the current report.

Table 1. The sets of data that were collected so far.

Cohort	N (pre)	N (post)
I	22*	21
II	14	11
III	16	-

In this report we focus on findings based on the open-ended question that referred specifically to the way teachers view the constructs "design" of TEL and "design-research" as relevant for their TPD. The analysis of teachers' answers was based on Chi's (1997) approach for quantification of qualitative data. Using a rubric developed especially for this study, each answer was assigned a value between (-1) and (+1) for each of the constructs, which we refer to as their TPD relevance index (Table 2).

Table 2. Rubric for analyzing the open-ended question

Relevancy of construct to TPD	TPD relevance index value	Example excerpt
Definitely not relevant	-1	(Design-research) " <i>research is not something I do as a teacher, teachers may design environments and work with their students but they don't study their learning</i> "
Probably not relevant	-0.5	(Design of TEL) " <i>I'm not sure yet that teachers can be good designers</i> "
Construct not understood or ignored	0	(Design-research) " <i>As a teacher of teachers it is very important for me to develop professionally and understand deeply what design and design-research mean so I, as a teacher and a teacher of teachers will be able to integrate technology in education</i> "
Probably relevant	0.5	(Design-research) " <i>I don't really know what that means but I think that it might be valuable</i> "
Definitely relevant	1	(Design of TEL) " <i>Design is essential, it is something every 'computerized' teacher has to learn</i> "

Findings and Discussion

Figure 2 shows teachers' views about the relevance of design and design-research to their professional development, based on the open-ended question. The figure illustrates that at preliminary stages of their participation in the program, teachers tended to value design of TEL much more than design-research as a potential contributor to their TPD. Significant differences were found for cohorts I and III (Mann-Whitney: $U=102.5$, $P<0.005$ for cohort I and $U=64$, $P<0.05$ for cohort 3). These views changed dramatically towards the end of the program, for cohorts I and II (yet to be studied for cohort III). In the post questionnaires teachers' sayings

reveal the major change in their perceptions towards the relevance of design-research for TPD. For example: "After getting to know the essence and purpose of design-research, I realized that carrying out such research may upgrade the teacher's professionalism. Involvement in such research empowers and intensifies the knowledge of teachers who integrate technology in their teaching".

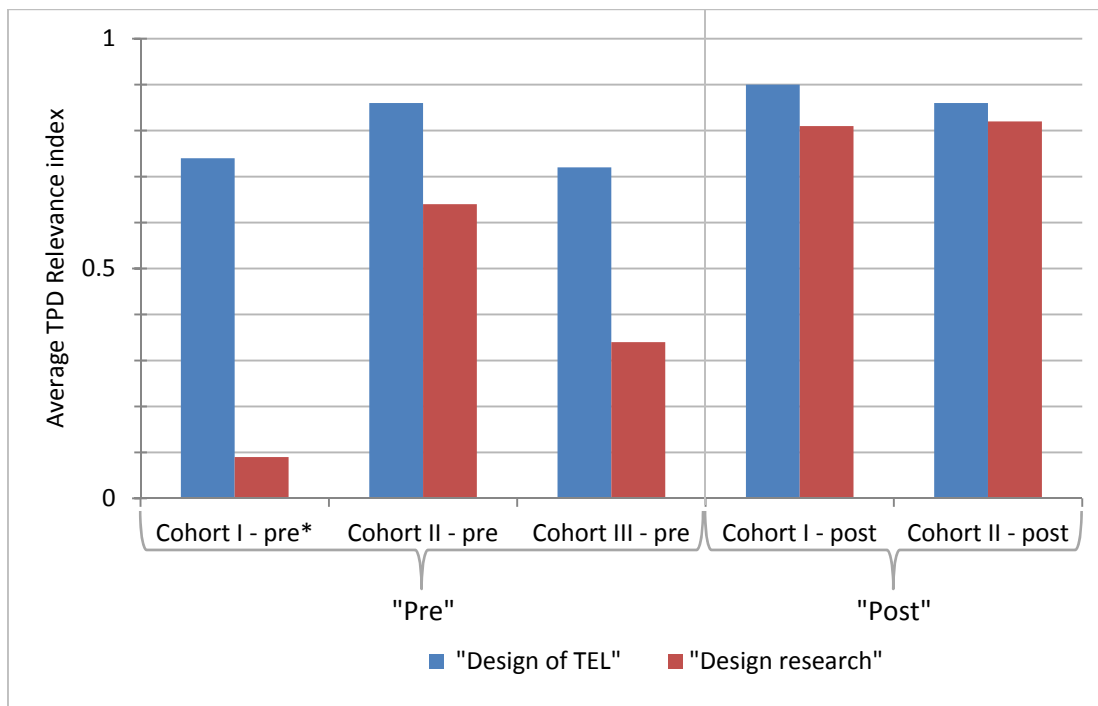


Figure 2. Teachers' views on the relevance of design of TEL and design-research for TPD

The contents of the answers, indicate that at preliminary stages of their participation in the program, teachers tended to view design-research as an activity totally unrelated to their everyday professional practices—an activity which is conducted mainly in the ivory tower of the academia. For instance "Since this is a new field, it is important that researchers will find out how people learn in an environment that integrates technology". In fact, some teachers even view research and teaching as competing enterprises, as expressed in the following excerpt: "Research and teaching are two contradicting skills, researchers are not necessarily skilled teachers and vice versa".

Conclusion

This study illustrates the power of TEL design-research for innovation in teachers' practice. We believe that in an era in which teachers are increasingly adopting the role of design as part of their practice (Laurillard, 2012), it is imperative that they will also develop a professional identity that will encourage them and provide them with tools to analyze how their designs impact learners, and thus enable them to modify their environments and embrace newer technologies as they advance. The dramatic rise in teachers' views regarding the relevance of design-research to their everyday professional practice in the current study indicates that the TaDR approach was effective. By modeling and gradually involving teachers in the three roles (mentor, TEL designer, and design-researcher) throughout the three courses, the teachers not only developed the skills required to conduct a small-scale TEL design-research, but also adopted a professional identity in which design-research plays a critical role.

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