Bringing Technology into the Classroom One Iteration at a Time

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Abstract

This design-based research explores professional growth of in-service English teachers in Israel. Participating teachers took part in one of two iterations of a professional development course focusing on the integration of technology in English teaching. Both iterations were designed based on a cognitive apprenticeship approach and the use of the model of Technological, Pedagogical and Content Knowledge (TPACK) as a lens for teachers to implement and evaluate the integration of technology in their own classrooms. The mediating process of reflection has been added to the second iteration in the form of reflective writing. Quantitative analysis of pre-post TPACK questionnaires shows significant improvement of teachers' perceptions in the first iteration. Results of the second iteration confirm and extend the findings of the first one. The course is a promising model for supporting teachers in developing the capacity for integrating technology into their everyday teaching.

Keywords: teacher professional development, TPACK, cognitive apprenticeship, reflective practice, DBR.

Introduction, Goals and Research Question

It is widely believed that technology holds great potential to enhance learning; however, the benefits do not come automatically by making technological tools available, but depend on the pedagogical details of the classroom implementation (Blake, 2013; Blau, et al., 2014; Zhao, 2003; Zhao & Lai, 2005). Numerous pre-service and in-service teacher professional development (TPD) courses have been designed and run to support teachers' use of technology. The process of professional development toward meaningful integration of technology in the classroom includes the increase of specialized knowledge of the interactions between technology, pedagogy and target material (Shulman, 1986; Mishra & Koehler, 2006; Koehler & Mishra, 2009). Additionally, designers of TPD courses should understand the professional growth networks in which teachers experiment and reflect on new possibilities (Clarke & Hollingsworth, 2002). It is these aspects which are used as lenses to explore teachers' learning in this iterative research project.

This research aims ***to understand the factors which contribute to teacher professional development in terms of pedagogically meaningful incorporation of technology within teaching.***

To meet this goal we designed a technology-enhanced learning (TEL) environment of TPD where we can foster, as well as explore this development. The TEL environment includes a set of learning activities for a TPD course of ten 3-hour sessions, with relevant shared resources

and editable spaces (Goodman & Zaritsky, 2012; Doryoseph, 2015). Thus far we have conducted two complete iterations of the course. This research paper describes the design refinements made in the course following the first iteration, details the development in participants' TPACK self-perceptions in each of the iterations and reports on a comparison of this development between the two iterations.

Specifically, two research questions were studied: ***(a) To what extent did the teachers' perceived TPACK change during each iteration of this course? and (b) How do the findings of the revised second iteration compare with those of the first?***

Theoretical Background

TPD programs and in-service training courses aim at providing teachers with guidance and resources that can provide them with tools for continuous change and growth related to their professional practices. Clarke and Hollingsworth's (2002) interconnected model of professional growth suggests that such changes occur in sequences and growth networks which include external input of new ideas, professional experimentation, identification of consequent salient outcomes and changes in a teacher's knowledge and beliefs all mediated by reflection and enactment. The order within such change sequences may not be the same for different teachers as the domains interact and influence each other (Figure 1).

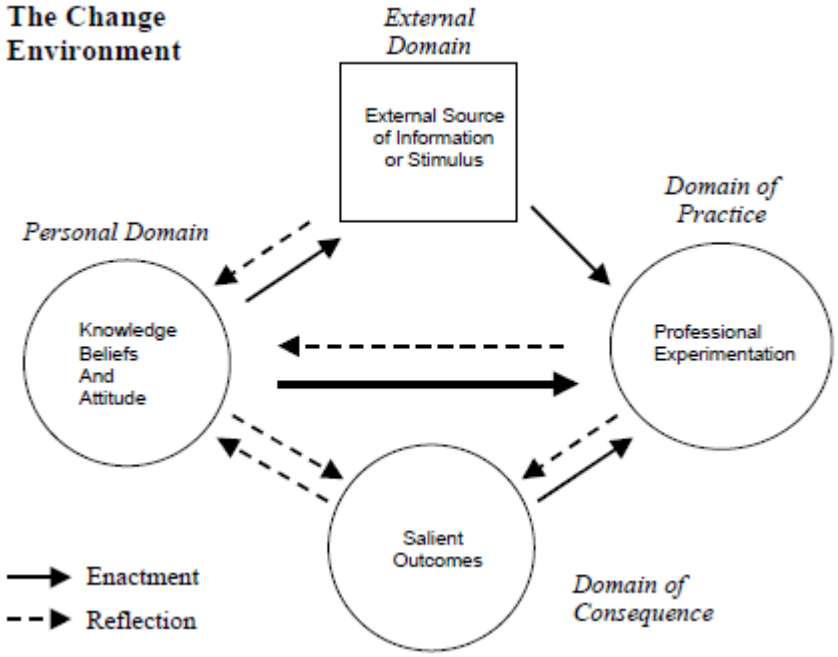

Figure 1. The model of professional growth (Clarke & Hollingsworth, 2002, p. 951)

Clarke and Hollingsworth's view aligns with that of Schön (1983, 1987) regarding the reflective practitioner who examines routine activities and learns from them in order to improve practice. Reflective practice encourages the type of questioning and reflective thinking through which changes in self-perception can be mapped (Schön, 1987).

In addition to reflective practice, the development of "professional vision" (Goodwin, 1994) is another contributor to teacher professional development. Goodwin explains that experts in every field are able to analyze situations involving their expertise and see things, which non-experts would not be aware of, due to their extensive knowledge about what they are observing. Expert support for novices' development of professional vision has three components. The first component is "highlighting" - drawing the novices' attention to specific features of interest; such as, asking what the pedagogical value of an activity is. The next component is "articulating" - explaining what is important, special or interesting in the highlighted feature (e.g. asking

participants to explain the added value of the chosen technical tool on that content or pedagogy). The third component is "coding" – using a professional language that provides necessary descriptive vocabulary.

Cognitive apprenticeship (Collins, 2006) proposes an approach that is based on modeling the way an expert would approach a specific task, this may include both “highlighting" and “articulating" the situation at hand. Next, the learners (who in this research are teachers participating in the course) are coached and provided with appropriate scaffolds that allow them to carry out similar tasks on their own with the aim of fading out to the point that the learners will gain enough independence to carry out such tasks independently. Cognitive apprenticeship is recommended as a pedagogical approach when the goal is the development of complex skills (Kali et al, 2015). As today's students are citizens of the 21st century they are surrounded with sophisticated information and technologies which require capabilities such as Communication, Collaboration, Creativity and Critical Thinking (Dede, 2010). The current research involves such complex skills related to Israel's national program to adapt education to the 21st century skills as well as assimilating technology in teaching (Ministry of Education, 2011) implying a need for teachers to acquire new technological and pedagogical skills.

One theoretical framework that assists in explaining the complexities of integrating technology in the classroom is the model of technological, pedagogical and content knowledge known as TPACK (Figure 2) defined by Mishra and Koehler (2006, 2009). This model stems from Shulman’s (1986) notion of pedagogical and content knowledge and their intersection (PCK) and adds the sphere of technological knowledge. Thus, the three spheres in the figure represent the types of knowledge necessary for teaching in the digital age, but more importantly, the various overlaps represent unique types of knowledge required for successfully integrating technology in the classroom (Mishra and Koehler, 2006).

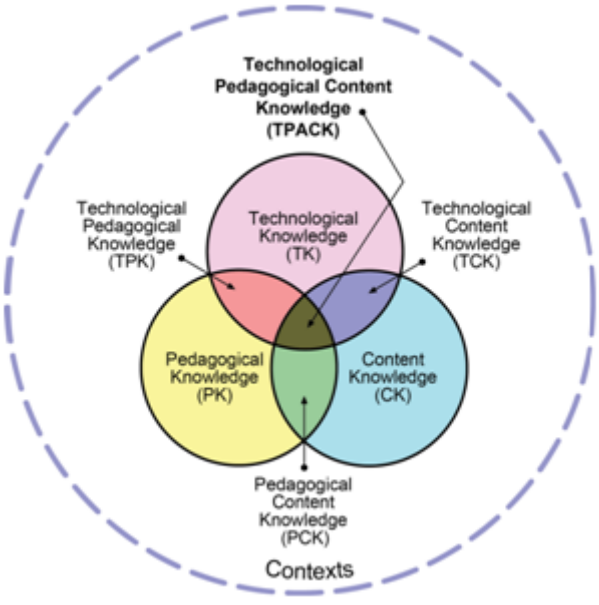

Figure 2. TPACK Reproduced with permission, © 2012 by tpack.org

Methods

This study was conducted using a design-based research (DBR) approach which included two iterations of designing learning environments, enacting them, observing them and assessing the outcomes. The findings of the first iteration were analyzed, the design was revised and the cycle began again (Collins, 1990; Barab & Squire, 2004; Barab, 2006).

Participants

In both iterations participants were teachers of English as a foreign language in Israel. The participants (16 in Iteration 1 and 10 in Iteration 2) attended "Teaching English in a Digital Age" in accordance with Israel's policy for teachers' professional development.

Data sources and analysis

A TPACK questionnaire (Schmidt, et al., 2009) which explores the self-perceptions of each participant's technological, pedagogical and content knowledge was administered at the beginning and toward end of each of the two iterations reported here. The questionnaire contains 29 questions on a Likert scale of 1 to 5. Statistical analysis was conducted on aggregated answers for all the questions of each the knowledge types (TK, CK, PK, PCK, TCK, TPK, and TPACK) in each iteration.

Design

The first iteration was designed on the principles of cognitive apprenticeship (Collins, 2006) as a teaching strategy, twenty-first century skills (Dede, 2010) as a pedagogical guide, and the model of TPACK (Mishra & Koehler, 2006) as a lens for teachers to evaluate TEL activities. The course incorporates cognitive apprenticeship elements such as: modeling (course activities were taught in a way that allowed participants to engage in the process as learners and later teach the same activities in their own classes as teachers), scaffolding (by providing "how to" explanatory video clips), and coaching (by providing feedback and suggestions on improving participants' activities). These are critical design elements which support teacher professional growth.

The course environment includes a website, built in Google Sites, which provides a framework for course activities, a reference point of shared resources, and a personal space for the teachers' reflections. The layout was not changed between Iteration 1 and Iteration 2 (Figure 3).

Figure 3. Homepage of the course website

Teachers in the first iteration significantly developed their TPACK skills (as described in the findings); however, they could not employ their newfound knowledge and newly developed skills in their classrooms due to limited access to technology. This led to shifting the technology-enhanced activities from computer-room based activities to more commonly-available-technology based activities (one pc and a projector or "pocket technology" including smartphones and tablets). Analytical discussions were designed in a repeated pattern in which the instructor elicits identification of the TPACK elements with emphasis on how the technological tool added value to the learning of the topic and met pedagogical goals. Following

the success in the first iteration, these analytical discussions of activities through TPACK lenses were preserved in the second iteration. Written reflections were added to encourage participants to think about how they could implement that session's activities in their own classrooms. In addition, discussions were held at the beginning of the following session to reflect on and analyze the participants' enactments. This is in keeping with Clarke and Hollingsworth's (2002) model, to further enhance teachers' learning by encouraging enactment and creating opportunities for reflection.

Findings

Research question 1: To what extent did the teachers' perceived TPACK change during each iteration of this course?

Analysis of teachers' pre and post TPACK questionnaires shows their TPACK perceptions increased in Iteration 1 as well as in Iteration 2. Figure 4 illustrates the increase in each of the TPACK knowledge types for both iterations.

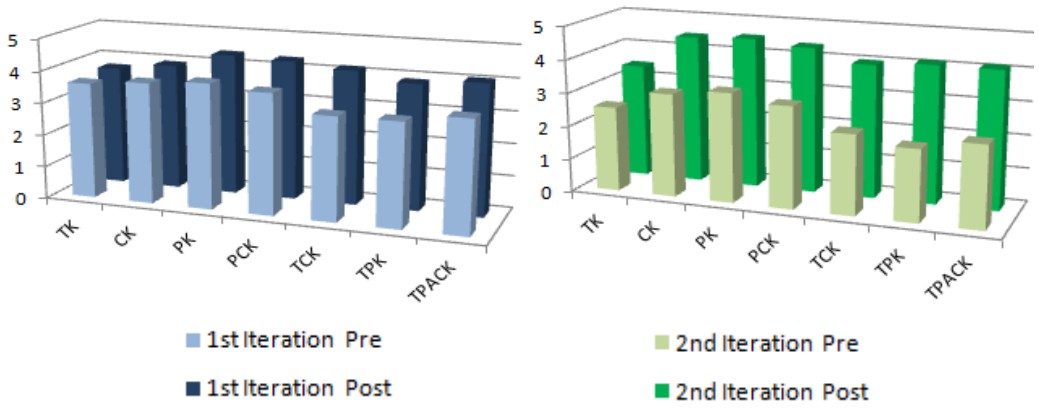

Figure 4. Aggregate Comparison of TPACK Scores Iteration 1 (left) and Iteration 2 (right)

All changes are statistically significant. Paired t-test analysis indicates significant increase $t(28) = -7.1506$, $p < 0.001$ between pre ($M = 3.59$, $SD = 0.33$) and post ($M = 4.04$, $SD = 0.28$) tests of Iteration 1. Paired t-test analysis indicates significant increase $t(28) = -15.57$, $p < 0.001$ between pre ($M = 2.77$, $SD = 0.25$) and post ($M = 4.13$, $SD = 0.24$) tests of Iteration 2.

Research question 2: How do the findings of the revised second iteration compare with those of the first?

As previously shown, both iterations had significant increases between participants' pre and post TPACK perceptions. We compared the rise in teachers' TPACK between the beginning and end of Iteration 1 ($M = 0.5214$, $SD = 0.2921$) to that of Iteration 2 ($M = 1.4386$, $SD = 0.3506$). A paired t-test analysis $t(6) = -9.6276$, $p < 0.0001$ indicates a dramatically significant increase in the second iteration as shown in figure 5.

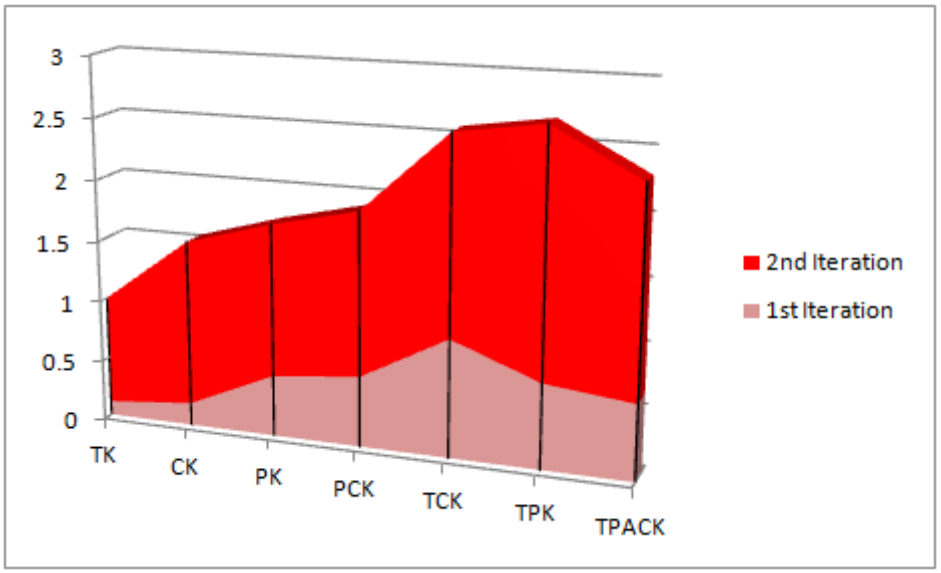

Figure 5. Rise in teachers' TPACK between the beginning and end of Iteration 1 versus that of Iteration 2

Discussion

Design-Based Research has been an effective approach for refining the design of the "Teaching English in a Digital Age" course which significantly improved teachers' TPACK perceptions. We believe that, based on Goodwin (1994) it is most probable that the discussions about course activities in which the participants articulated, highlighted and coded the technology, pedagogy, content and the connections among them were influential in enriching their professional vision and perception of their own knowledge. In our opinion, based on Clarke and Hollingsworth's (2002) model, at least some of the growth in the second iteration may be attributed to the increased opportunities to enact (in the classroom) and the mediating process of reflection (in the course) on integrating technology. For instance, participants were encouraged to bring their own experimentation into analytical discussions at the beginning of each session. Another example is the iterative enactment, refinement and reflection on the TEL activity teachers designed. Although the number of participants in the first two iterations is small, this limitation is an opportunity for expansion in the future.

We claim that the design elements of the course (i.e., TPACK discussions, having the teachers experience the use of technological tools as learners prior to teaching, and written reflections as part of each learning-enactment cycle) can be applicable to the incorporation of technology in teaching any subject matter. The TPACK framework (Mishra & Koehler, 2006) can serve, regardless of the topic, to emphasize the connections between the technology and pedagogy to the content, while the principles of cognitive apprenticeship (Collins, 2006) support teachers' learning, experimentation and reflection. Ultimately, such professional development can lead to improved integration of technology in teaching.

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