Computers & Education 58 (2012) 1351–1359

Contents lists available at SciVerse ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the 'will, skill, tool' model and integrating teachers' constructivist orientations

Dominik Petko*

University of Teacher Education, Central Switzerland, Schwyz - Zaystr. 42, 6410 Goldau, Switzerland

ARTICLE INFO

Article history:
Received 2 August 2011
Received in revised form
28 November 2011
Accepted 13 December 2011

Keywords:
Media in education
Improving classroom teaching
Pedagogical issues
Secondary education

ABSTRACT

The 'will, skill, tool' model is a well-established theoretical framework that elucidates the conditions under which teachers are most likely to employ information and communication technologies (ICT) in the classroom. Past studies have shown that these three factors explain a very high degree of variance in the frequency of classroom ICT use. The present study replicates past findings using a different set of measures and hones in on possible subfactors. Furthermore, the study examines teacher affiliation for constructivist-style teaching, which is often considered to facilitate the pedagogical use of digital media. The study's survey of 357 Swiss secondary school teachers reveals significant positive correlations between will, skill, and tool variables and the combined frequency and diversity of technology use in teaching. A multiple linear regression model was used to identify relevant subfactors. Five factors account for a total of 60% of the explained variance in the intensity of classroom ICT use. Computer and Internet applications are more often used by teachers in the classroom when: (1) teachers consider themselves to be more competent in using ICT for teaching; (2) more computers are readily available; (3) the teacher is a form teacher and responsible for the class; (4) the teacher is more convinced that computers improve student learning; and (5) the teacher more often employs constructivist forms of teaching and learning. The impact of constructivist teaching was small, however.

1. Introduction

Despite the availability of computers and Internet connections in many schools, it is often noted that such technology is seldom employed in actual teaching practice (Korte & Hüsing, 2006; Shewbridge, Ikeda, & Schleicher, 2006). Given the high level of importance ascribed to information and communication technologies (ICT) in current discussions about education policy (e.g. Delors, 1998; Kozma, 2008; Rychen & Salganik, 2003), educational researchers need to address why so many schools have been so slow to adopt digital technology, and why so many teachers remain skeptical about integrating digital technologies in their classroom teaching or remain rather conservative in their ways of using technology. Larry Cuban (2001) has aptly described this situation and questioned the transformative potential of digital media:

> From my inquiry into Silicon Valley Schools I have concluded that computers in classroom have been oversold by promoters and policymakers and underused by teachers and students. I predict that the slow revolution in technology access, fueled by popular support and continuing as long as there is economic prosperity, will eventually yield exactly what promoters have sought: every student, like every worker, will eventually have a personal computer. But no fundamental change in teaching practices will occur. (pp. 195–196)

Many international case studies and quantitative surveys have sought to explain the preconditions for successful and transformative integration of ICT in schools (Becker, 1999; Eickelmann, 2011; EUN Consortium, 2004; Kozma, 2003; Korte & Hüsing, 2006; Law, Pelgrum, & Plomp, 2008; Mueller, Wood, Willoughby, Ross, & Specht, 2008; Pelgrum, 2001; Venezky & Davis, 2002). These studies have found that the problem cannot be solved by simply removing "barriers" preventing increased use (Jones, 2004) while also enhancing the "enablers" that

* Tel.: +41 41 8590592; fax: +41 44 8590570.
E-mail address: dominik.petko@phz.ch.

0360-1315/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
doi:10.1016/j.compedu.2011.12.013

are associated with increased use (Scrimshaw, 2004). Instead, the real challenge is to address a complex interplay of multiple factors at several levels (Mumtaz, 2000; Somekh, 2008; Webb & Cox, 2004). These factors can be differentiated at the *individual* level (e.g. competencies and beliefs of teachers and students), at the *school* level (e.g. the school administration, school culture, academic strategies, infrastructure, internal continuing education, professional development and educational leadership; for an overview see Daly, Pachler, & Pelletier, 2009; Hadjithoma-Garstka, 2011) and at the *educational system* level (e.g. educational policies and, curricula). Yet despite this complexity, there appears to be a fairly broad consensus that emphasizes the teacher's individual qualities, and, above all, pedagogical beliefs (Becker, 2000; Ertmer, 2005; Gobbo & Girardi, 2001; Higgins & Moseley, 2001; Jimoyiannis, 2007; Lim & Chai, 2007; Teo, 2008; Windschitl & Sahl, 2002). Regardless of the intensity of well-intentioned efforts at other levels (such as improvement of hardware, software and content, the adaptation of curriculum procedures and academic strategy papers, or the providing of continuing education, coaching,support and educational leadership), all remedial measures will ultimately prove futile unless teachers have a fundamentally positive attitude toward the potential benefits of ICT. Therefore, Ertmer (2005) suggests that teachers' beliefs constitute the "final frontier" for successful ICT integration.

2. Theoretical background and research hypotheses

2.1. The will, skill, tool model

General *technology acceptance models* suggest that the core factors affecting the subjective evaluation of the *perceived usefulness* of a technological innovation are linked to an estimation of their *ease of use*. Additional moderating variables include gender, age, experience, the perception of social desirability of the use of an innovation, and a good fit with existing conditions. Taken together, these variables explain 70% of the variance in intent to use, and 40% of the variance in actual use (Legris, Ingham, & Collerette, 2003; Venkatesh, Morris, Davis, & Davis, 2003). However, while this model has been useful for predicting the acceptance of Internet banking and telecommunications services, it cannot simply be transposed to the realm of schools. We need to determine which *specific* characteristics of teachers and the school context influence the use of computers in the classroom.

The *will, skill, tool* model, developed specifically for teachers, identifies three core variables which, according to earlier findings, can explain 90% of the variance in the level of ICT integration in the classroom (Christensen & Knezek, 2008; Knezek, Christensen, Hancock & Shoho, 2000; Knezek, Christensen & Fluke, 2003; Morales Velázquez; 2006). This model has gained prominence through its integration in the recent *International Handbook of Information Technology in Primary and Secondary Education* (Voogt & Knezek, 2008) and subsequent studies (e.g. Agyei & Voogt, 2011). A similar *access, competence, motivation* model has been proposed by Viherä and Nurmela (2001) and was used as the analytic framework for the major European study of Korte and Hüsing (2006). The critical variables for a high level of ICT integration in these models are a positive attitude on the part of the teacher toward the use of computer technology in the classroom, good skills in working with the technology and its fields of application, and finally, sufficient access to the devices. To some extent, the remarkably high explanation of variance by the *will, skill, tool* model in former studies may be an artifact of the survey instrument and thus, can be criticized. The validity of the *will, skill, tool* model was always tested by asking teachers to evaluate their ICT activities using a descriptive step model. The questionnaire included a mixture of questions about the quality and quantity of ICT use. The teachers' "stages of adoption" ranged from Stage 1 ("awareness" wording: "I am aware that technology exists but have not used it - perhaps I'm even avoiding it. I am anxious about the prospect of using Computers") to Stage 2 ("Learning the process), Stage 3 ("Understanding and application of the process"), Stage 4 ("Familiarity and confidence"), Stage 5 ("Adaption to other contexts"), and, finally, Stage 6 ("Creative application to new contexts." wording: "I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum."). In the *will, skill, tool* model, this six-stage rating scale, along with two other comparable scales, constitutes the central dependent variable. Although such ratings scales relate more aptly to the quality than the quantity of ICT use, they are only of limited value as the dependent variable in the model cited, since the way they are formulated may create confusion between issues of competency and attitude. This is particularly evident in the wording of Stage 4: "I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer." As a consequence, the very high explanation of variance by *skill* and *will* factors should hardly be surprising in relation to these levels. As with all qualitative level models, questions also arise regarding the transitive nature of the sequence of levels: successful ICT integration does not necessarily occur in these stages. Therefore, simpler and less inferential measurements of the quality and quantity of ICT use in the classroom may be a more valid alternative. To help us confirm the utility of the *will, skill, tool* model, we need to more sharply differentiate and demarcate its individual elements.

To differentiate among the *tool* variables, for example, we would need to consider not only the average number of devices the teacher has available per student, but also whether these devices are they up-to-date and well maintained, and the ease and flexibility of computer access at the school. It can make a big difference whether the devices are located in the classroom itself, are distributed to the students in class from a notebook computer pool, or are only accessible in specialized computer rooms.

To differentiate among the *skill* variables, we must first be able to separate the teacher's *personal* ICT competencies in the use of hardware and software, from *professional*, *pedagogical* and *didactic* competencies to support learning processes for students being taught using digital media. Another axis of differentiation in skills could focus on specific teaching content, or "technological pedagogical content knowledge" (Mishra & Koehler, 2007).

At a minimum, variables related to *Will* need to be differentiated into ICT-specific and general attitudes. However, there is still some lack of clarity regarding the importance of pedagogical *beliefs*, and we should begin by examining them from a theoretical perspective.

2.2. Teachers' ICT-specific beliefs

Motivation may best be understood as a cognitive system for directing concrete and situation-specific behavior, which is regulated by multiple factors (Heckhausen & Heckhausen, 2008). By contrast, values and beliefs are best understood as generalized cognitive patterns that are also relevant for directing and evaluating behavior, but at a significantly higher level of generality. There is an extensive scientific debate about the genesis and mutability of the pedagogical *beliefs* held by teachers, and this debate extends well beyond the question of