Technology Integration Studies in Elementary Education

SIG 'Technology as an Agent of Change in Teaching and Learning'
Symposium proposal

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Session abstract

Within the context of the knowledge society, teachers are responsible for incorporating the use of computers and technologies in ways that will help their students learn 'twenty-first century skills'. Helping teachers effectively integrate technology has become a major challenge for elementary schools. In this context, researchers are investigating how - and under what conditions - technologies are being used to support teaching and learning processes. This international panel of researchers is examining technology integration in elementary schools. The series of papers sheds light on the complexity of technology integration: underlining the differential impacts of technology, and the necessity to focus on a variety of supporting conditions. The papers illustrate that researchers can have different relationships with teachers during their projects.

Session Summary

Objectives of the session

Within the context of the knowledge society, teachers and schools are charged with using computers and Internet technologies in their practices to improve students' 'twenty-first century skills' (Anderson, 2008). ICT integration for teaching and learning is becoming a major task for elementary schools (Vanderlinde, e.a., 2009). In this context, technology integration researchers are investing how - and under which conditions - computers and Internet applications support teaching and learning processes (e.g. Hew & Brush, 2007; Vanderlinde & van Braak, 2010). This means that technology integration researchers have a twofold research focus. On the one hand, they investigate whether and how the use of computers, technologies and Internet applications in education impact students' learning processes and teachers' teaching behaviors. On the other hand, they identify teacher conditions (e.g. attitudes toward computers), and school-level organizational conditions (e.g. leadership) that support the use of technologies for teaching and learning.

For this symposium we have assembled an international panel who are currently investigating this topic to further our understanding of technology integration in elementary education. Through this symposium, we will share research results and methodological problems, ideas for future research, and implications for policy and practice.

Overview of the presentations
The papers presented are drawn from seven different research groups from five countries. Symposium participants will first present the research context of their studies and the nature of the technology integration research question. Special attention will be given to methodological issues. Two papers are based on representative teacher samples, three are based on local classroom integration projects.
The symposium is not only of high relevance for researchers, but also for teachers, school leaders, and school administrators. Collectively, the studies span a range of contexts and methodological diversity that should attract a broad academic audience: (1) The first paper presents a multilevel model of different independent school and teacher variables that explain the use of technology in elementary schools; (2) Like the first paper, the second paper is also based on a representative sample, but has a specific focus on innovative technology use; (3) The third paper reports on the effects of initiating a 1-1 laptop program on teachers' pedagogy; (4) The fourth paper has a speciic focus on the durability of technology use, and compares traditional within innovative technology schools; (5) The last paper describes research on micro ethnographic classroom studies on technology integration. Interestingly, all symposium researchers have other relationships with the teachers who participate in their research studies. They represent the broad spectrum of researcher / practitioner relations described by Wagner (1997), ranging from 'data-extraction agreements' (Paper 1 and Paper 2), 'partnerships agreements' (Paper 3 and Paper 4), to 'co-learning agreements' (Paper 5).

Scholarly significance
The theme discussed in this symposium, technology integration in elementary schools, is a crucial one in the field of technology integration research. By comparing research results from all over the world, symposium participants hope to provide insights into technology integration at the elementary level, and how it can be further supported.

Structure of the session
The session will begin with a brief five-minute introduction. Each of the panelists will be allotted 15 minutes for their presentation and clarifying questions. Following the presentations, the discussant will provide a 15-minute summary, followed by a 20-minute question period involving the audience and panel.

Paper 1 – Institutionalized Technology Use in Elementary Schools: A Multilevel Approach

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Koen Aesaert, Ghent University, Belgium
Johan van Braak, Ghent University, Belgium

Objectives and purposes. This study uses a multilayered framework of different independent school and teacher variables to study which conditions explain the use of technology in Flemish (Belgium) elementary schools. Special attention is paid to widely accepted technology uses by teachers, which is regarded as 'institutionalized technology use'.

Theoretical framework. Within the context of the knowledge society, teachers and schools try to make use of educational technology in their practices to improve students' 'twenty-first century skills' (Anderson, 2008). Technology integration for teaching and learning is becoming a major task for elementary schools (Vanderlinde, Hermans, & van Braak, 2009). This study is situated within the technology integration research tradition (e.g. Kozma, 2003). Researchers in this tradition search for factors - situated on different levels (e.g. student, teacher, school, and policy) - that support the use of technology for teaching and learning (Cox, 2008).

Method. A questionnaire has been administered to a representative teacher sample (N=433) in 53 Flemish elementary schools. Factor analysis and multilevel analysis have been conducted.

Data sources and evidence. Independent variables were the school and teacher conditions described in the e-capacity framework of Vanderlinde and van Braak (2010), and the educational beliefs scales of Hermans et.al. (2008). The e-capacity framework was developed from a school improvement perspective and consists of conditions fostering the integration of technologies into teaching and learning practices. Conditions are clustered into three mediating subsets of variables: technology related teacher conditions, technology related school conditions, and school improvement conditions. The dependent variable 'institutionalized technology use' was constructed based on item mean analysis on four existing technology use scales (Tondeur, e.a., 2009, Vanderlinde & van Braak, 2010): the use of basic technology skills, technology as a learning tool, technology as an information tool, and innovative technology use. This new variable (13 items) showed good internal consistency (Alpha = .87).

Results. The results of the multilevel analysis illustrate that institutionalized technology use should not only be considered as a teacher phenomenon but also as a school artifact. The null model clearly shows that almost 14% of the variance in technology use is due to between-school differences. In a final model, the variables 'technology professional development', 'technology competences', 'developmental educational beliefs', and 'schools' technology vision and policy' are identified as predictors for 'institutionalized ICT use'. In this context, it is remarkable that the two specific technology related teacher conditions accounted for 23% of the variance at teacher level, and even for almost 38% of the variance at the school level. This illustrates that schools as organizations have a major role to play in the development of individual teacher technology competence and interconnected technology professional development activities.

Scientific and scholarly significance. By presenting a multilevel model of influencing school and teacher level conditions, this study sheds light on the complex process of technology integration in primary education. As such, the results are of particular importance for both researchers and policy makers in the field of technology integration.

Paper 2 – Institutional Factors and Teacher Characteristics Affecting Classroom Technology Use: Evidence from a Nationally-representative Survey

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Objectives and purposes. The innovative use of technologies in education is still the domain of a relatively small number of teachers, especially outside the most advanced countries. We start from the premise that practices that encourage independent, collaborative and autonomous learning (Kozma & Anderson 2002) better prepare students for life in the "knowledge society" and hence should be encouraged through appropriate policy measures. On the basis of nationally-representative Spanish survey data on teachers' attitudes, experience with, and use of new technology, we attempt to identify particular resources that innovative technology users are drawing upon.

Theoretical frameworks. In particular, we try to answer the question whether the contributing factors for innovative use are mainly "manipulative" or "non-manipulative" (Drent & Meelissen 2008), i.e. amenable to be influenced by schools or requiring broader policy intervention.

Method. In a first descriptive part of the analysis, meaningful groups of teachers are formed on the basis of their reported technology use in the classroom. In a second step, we aim to develop a parsimonious and relevant model for classifying teachers into these different groups on the basis of institutional and individual variables. Concretely, cluster analysis is employed to develop a taxonomy of teachers with regard to technology classroom use. We distinguish between three types of technology users based on the frequency and variety of classroom use. Discriminant analysis is then employed to predict membership in these user groups from a set of "structural" and "cultural" characteristics at both the individual and school levels. Different robustness checks are performed, in particular the regression of an index of innovative use on the same set of variables.

Data sources and evidence. Data is based on a nationally-representative survey on teachers' attitudes, experience with, and use of new technology in Spanish primary and secondary schools (Sigalés et al. 2008). The stratified multi-stage sampling procedure yielded a sample of 1697 teachers, 653 of which were retained in our final analysis.

Results. The hypothesis suggested by our analysis sees *access to internet and technology resources at school* as well as *digital literacy for advanced internet use* as the most important predictors for innovative use of technology in education. Of slightly less importance are *frequency of internet access* and *educational technology training* as well as *positive technology attitudes* by teachers. On a more detailed level of analysis, the results suggest that the availability of networked computers in classrooms, as well as easy access to programs and other software are considered helpful factors by more heavy technology users. An important non-manipulative teacher characteristic of some importance is the ability to publish contents on the internet.

Scientific and scholarly significance. We conclude that infrastructure bottlenecks, which are clearly a manipulative school-level factor, might still be the appropriate locus of intervention for schools that attempt to encourage innovative technology use. There might also be a significant payoff in refocusing some of the efforts in education for teachers beyond basic computer skills on more intermediate internet and Web 2.0 competences.

Paper 3 – Affects of an Elementary School One-to-one Initiative on Teachers' Pedagogical Beliefs and Practices

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Objective. To examine changes in elementary teachers' pedagogical beliefs and practices when one-to-one computing is initiated in their school.

Theoretical-framework. Teachers tend to teach in ways that are consistent with their basic beliefs about how students learn (Richardson, et al., 1991); and this has affected the ways teachers have integrated the use of digital technologies into their practice (Niederhauser and Stoddart, 2001). Early integration efforts typically situated technology in laboratories, which severely limited access; and student use typically involved traditional pedagogical approaches like using drill-and-practice software to help students develop basic skills; keyboarding, word processing and PowerPoint-driven book reports; and Internet-based scavenger hunts (Willis and Mellinger, 1996; Niederhauser and Lindstrom, 2006).
Over time, educators attempted to increase access and enable more constructivist technology use by distributing technology around the school—placing a few computers in each classroom and/or providing laptop carts to be shared among classes of students. These efforts accelerated as schools and districts across the US instituted one-to-one initiatives (Argueta, et al., 2011), with the Maine Learning and Technology Initiative reporting 100% of middle schools providing laptop computers for their students, and an additional 55% of high schools with one-to-one programs (MLTI, 2010).
While not as comprehensive as the Maine initiative, over 100 Iowa school districts have put one-to-one programs in place—about 25% of districts in the state (McChesney, 2011). Further, while Maine focused on infusing technology into middle and high schools, Iowans included elementary schools in one-to-one initiatives. This has provided a unique opportunity to examine how elementary teachers' beliefs about learning and pedagogy adapt to the ubiquitous technology inherent in a one-to-one classroom. For the present research, we used the TPACK framework (Mishra and Koelher, 2006) to examine how these elementary teachers' pedagogical beliefs and practices changed during their experiences as a first-year one-to-one teacher.

Method. Case study methodology (Yin, 2009) was used to conduct this study. Data were collected using semi-structured interviews and a researcher developed observation protocol that was grounded in the TPACK framework. Constant comparative method (Glaser & Strauss, 1967) was used for analysis.

Data-sources-and-evidence. The research site was a single elementary school in a small rural/suburban school district in the Midwestern US. All teachers in the school were invited to participate in the study. Teachers participated in an initial interview before the school year started, and bi-weekly interviews and observations during the year.

Results. Preliminary analyses suggest that teachers are initially intimidated by the prospect of teaching in a one-to-one classroom. Concerns included lack of relevant professional development, likelihood of technical problems, and perceptions that students were more technologically-savvy than they were. Over time, some teachers became more willing to shape their practice in ways that took advantage of ubiquitous technology access to promote more student-centered pedagogy. Others were more inclined to limit their students' use of technology, and to incorporate the technology in ways that tended to replicate more traditional teacher-centered practices.

Scientific-or-scholarly-significance. This research provides insights into changes in teachers' pedagogical beliefs and practices in a one-to-one computing program.

Paper 4 – Durable Integration of Technology Use in 'Traditional' and 'Innovative' Schools

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Objectives. Many studies on the use of educational technology describe technology use in terms of technology integration (cf. Hew & Brush, 2007; Vanderlinde, 2011). In this study however we focus on the extent to which technology use becomes integrated, i.e. 'embedded', in the classroom practice. The durability of the technology use is presumably an important indicator of this embeddedness.

Theoretical framework. Many studies indicate that in order for instructional technology integration to be successful, it needs to be in line with the school's educational concept or educational views (Kulik, 2003; Ten Brummelhuis, 2006; Webb & Cox, 2004). A minimal distance between the technology innovation on the one hand and the school's culture and the teacher's current practice on the other hand warrants the success of the integration (Zhao, Pugh, Sheldon & Byers, 2002).

Method. In the Netherlands five schools, two 'traditional' (teacher-directed, standards-orientated) and three 'innovative' (student-centered), participated in a two-year project on

'concept-guided development' of technology use. Teachers developed and implemented four technology-supported learning arrangements in line with their school's educational concept. Each learning arrangement was studied by a team of researchers. The teachers provided a hypothesis for each sub-study and participated in the data collection. The teachers' active involvement was expected to promote their sense of ownership, another condition for successful educational innovation (Fullan, 1999).
In this present study we investigated whether or not the technology use developed by the teachers became durably integrated in the schools' educational practice and how differences in the durable integration could be explained.

Data sources and evidence. Throughout the project semi-structured focus group interviews were held with a number of teachers at each school. At one 'traditional' school and one 'innovative' school a final interview was held one year after the project ended. From content analysis on these final interviews we draw conclusions about the extent to which the developed technology use was continued at these two schools after the project. Content analysis on the other interviews provides a rich context for these conclusions and provides possible explanations for differences that were found between the two cases.

Results. At both schools three out of four learning arrangements that were developed during the project continued to thrive after the project.
At the 'traditional' school the teachers' tight, textbook-driven, schedule appeared to be the main cause for the discontinuation of one learning arrangement, in which the teachers designed interactive instruction lessons with a digital whiteboard (IWB). At the 'innovative' school the teachers indicated the complexity of a school-wide technology innovation (implementing an electronic learning environment) as the main barrier for the continuation of one of the learning arrangements. This learning arrangement revolved around an electronic database with multiplication exercises.

Scientific or scholarly significance. We conclude that each educational concept may face significantly different challenges in the durable integration of technology use. Data from the other schools confirm this impression. As this has considerable implications for technology innovation projects, further research is needed.

Paper 5 – Micro Ethnographic Research as a Method for Informing Educational Technology Design in Practice

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Objectives and purposes. This paper describes research on how micro ethnographic classroom studies (Mehan, 1979) of the integration of technology can inform researchers understanding of teachers and children's situated acts with technology. Hence, the objective of this paper is to show stories of the integration of technology from the teachers and children's perspective.

The central research question of the study is: *how can researchers of educational technology represent the local and situated action of teachers and children to inform future technologies?*

Theoretical frameworks. Integrating technology in classrooms can be approached at many different levels. From a curriculum perspective, these levels refer to the macro, meso, micro, and the nano level (Akker, Kuiper, & Hameyer, 2003). At every level there seems to be a gap between researcher and practitioners, even at the nano level. Hence, educational technology researchers discuss how to bridge the gap between researchers and practitioners (Vanderlinde & Van Braak, 2010). Similar, there is also a gap between educational technology developers and practitioners. This gap between developers of technology and the users have been described in the Scandinavian tradition of system development (Greenbaum, 1991) and the holistic perspectives on the integration of technology in to work life (Berg, 1998). As a basic premise the researchers of this paradigm stress that understanding the customs of the local ecology (Nardi & O'Day, 1999) is important when you want to change and integrate technology in practice. Facing this gap, researchers need to become ethnographers of work and inform the world of the technologist and practitioners.

Methods. The methodological approach is shaped by a variety of disciplines, including Scandinavian system development, socio cultural learning theory, and ethnography and interaction analysis. Mehan (1979) and colleagues studied the structure of lessons by conducting what they called constitutive ethnographic using video cameras to capture the activities in the classroom. This approach allowed the researchers to understand the world of the children and teachers. Besides, by showing teachers videos of their own practice the researchers were able to validate their observations. To put differently, if a researcher cannot describe teachers and children's practice so they can understand it, then their ethnographic work has failed.

Data sources and evidence. Throughout one year researchers participated in the daily life of the classroom and recorded more than 150 hours of video data. Small extracts of the video was shown to the teachers in order to align the perspective of the teachers and researchers. During these meetings the teachers provided important insights of the classroom order and their experience of using technology in classrooms.

Results. Results show that introducing technology into the classroom as a learning tool posed a challenge to the pedagogic approach, the teaching materials and the roles of both teachers and learners. Furthermore results suggest that a micro ethnographic methodology can inform both researchers, technologist and teachers.

Scientific or scholarly significance. The paper provides methodological, theoretical and empirical arguments for how educational technology studies can take departure in the local and situated and inform future educational technology designs.

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