## Concept-guided development of classroom use of ICT

*Concept-specific types of ICT use and their integration into teachers' practices*

de Koster, S.

**Publication date**
2017
**Document Version**
Other version
**License**
Other

# Chapter 6 Summary and general discussion

There have been considerable efforts over the past few decades to promote and facilitate the use of classroom technology, which can include anything from drill-and-practice software for maths and literacy skills, to students presenting their own videos on an interactive whiteboard or learning in a virtual reality setting. The expectations regarding the possible benefits of ICT for teaching and learning are high (Aesaert, Vanderlinde, Tondeur, & van Braak, 2013; Dede, 2010; Lemke, Coughlin, & Reifschneider, 2009; Voogt & Pelgrum, 2005; Voogt & Roblin, 2012). Yet the expected integration of technology use and its subsequent effects on teaching and learning in most schools are not being realised (Lemke et al., 2009; OECD, 2015).

The overarching purpose of this dissertation was to investigate whether concept-guided development of ICT use in education is a promising approach that can promote the integration of technology into teachers' practices. A growing body of literature indicates a crucial link between pedagogical beliefs and the use and integration of ICT (Ertmer, 2005; Hermans, Tondeur, van Braak, & Valcke, 2008; Kim, Kim, Lee, Spector, & DeMeester, 2013; Liu, 2011; Zhao, Pugh, Sheldon, & Byers, 2002). Research has shown that a good fit between the educational concept of the school and its ICT use is an important condition for the successful integration of ICT into educational practices. Zhao, Pugh, Sheldon and Byers (2002) found that a minimal distance between the ICT innovation and the school's culture and practice promotes the integration of the innovation. Similarly, Tolmie (2001) showed that how and to what effect ICT resources are used depends on how well they fit in with the established patterns of activity in the school, while according to Niederhauser and Stoddart (2001) teachers are inclined to apply technology in a manner that is consistent with their personal perspectives about curriculum and instructional practice.

Concept-guided development of technology use aims to utilise the mechanism that teachers tend to use technology in ways that fit their teaching practices by starting from

a reflection on the school's educational concept – i.e. the educational views (values, beliefs, perspectives) on which its classroom practices are based. The purpose of this approach is to develop technology use that fits the school's educational concept and thereby increase chances for successful integration of the technology use. Thus it aims to contribute to helping schools to close the gap between the promise of classroom technology and the realisation of this promise.

The research presented here was conducted in the context of a project[6] in which teams of teachers in five primary schools in the Netherlands participated. Two schools had a 'traditional' educational concept, the label 'traditional' referring to a fixed curriculum and a strongly teacher-directed approach. The other three schools had an 'innovative' educational concept, which meant that these schools had a more open curriculum and a student-centred approach.

The schools developed ICT-rich learning arrangements in a concept-guided way, so that the ICT use would fit their educational concepts. A learning arrangement would consist of a lesson plan, and could concern any school subject or combination of subjects. The technology use in a learning arrangement could entail anything from the use of 'drill-and-practice' software to the use of a wide range of technological tools to support a variety of learning activities in an inquiry-based project. Across the schools a total of seventeen learning arrangements were developed during the project.

It was expected that by taking the school's educational concept as a starting point for developing new ICT use, this concept-guided approach would promote the integration of classroom ICT use. We investigated the resulting technology use and its integration into the teachers' classroom practices in the participating schools. The overarching research question was:

*To what extent does a concept-guided approach in schools with either a 'traditional' or an 'innovative' educational concept contribute to the development of ICT use that becomes integrated into the teachers' classroom practices?*

[6] This was called the Cumulus project, initiated by educational consultancy company APS and financed by the Dutch public organisation for education & ICT Kennisnet and APS. VU University Amsterdam and HAN University of Applied Sciences supplied the research staff.

Four studies were conducted to answer the main research question. In this final chapter the main findings and conclusions of these four studies are summarised and the conclusions are discussed with regard to their implications for theory, practice and further research. Finally, some overall conclusions are drawn with regard to the main research question.

**Summary of the main findings and conclusions**

The first two studies, Part I of this dissertation, focused on describing the technology use that resulted from the concept-guided approach in the participating schools. ICT can support different types of teaching and learning (Niederhauser & Stoddart, 2001; Higgins & Spitulnik, 2008; Inan, Lowther, Ross, & Strahl, 2010). Both learner-directed and teacher-directed learning can be supported by ICT (Ten Brummelhuis & Kuiper, 2008) and it can facilitate the individualisation of learning processes as well as support learning within a learning community (Volman, 2005). In our **first study** (chapter 2) we therefore aimed to answer the following research question: To what extent does concept-guided development of ICT-enhanced learning arrangements in primary schools lead to distinguishable types of ICT use?
The ICT use was operationalised in terms of the tools that were used, the activities in which they were used and the goals that were expected to be achieved through the ICT use. The study included case studies of all five schools that participated in the project. The results of the study showed that concept-guided development of ICT-enriched learning arrangements indeed resulted in clearly distinguishable types of ICT use in the two types of schools. At the two 'traditional' schools typically only one or two ICT tools were used within one learning arrangement, mainly supporting the use of standard teaching materials with fixed learning content and a strongly teacher-directed approach.

The learning arrangements at the three 'innovative' schools were characterised by use of a wide range of ICT tools that supported explorative, open-ended activities with considerable input from the students. At one school visual tools played a significant

role; at the other schools the internet and other tools that facilitate explorative activities were used most prominently. Some ICT tools, primarily the computers and the interactive whiteboard (IWB), were used in both school types, yet in different ways, reflecting the differences between the two school types. To an extent the teachers in both school types also formulated similar goals for the ICT use they developed. Across the school types the teachers formulated goals with regard to enhancing student motivation, learning results, self-directed learning and differentiation. Yet the different ways in which the tools were used to work towards these goals seemed to reflect the different expectations with regard to ICT and learning that the schools have. At the 'traditional' schools, enhanced motivation was expected because of the variation in instructional and exercise formats facilitated by ICT, whereas the teachers at the 'innovative' schools expected higher motivation through enhanced meaningfulness of learning activities. With regard to learning results, the 'traditional' schools focused on knowledge acquisition through ICT, while the 'innovative' schools mainly focused on the development of skills. As for self-directed learning, at the 'traditional' schools, the focus was on performing learning tasks with less assistance from the teacher, whereas at the 'innovative' schools, ICT was expected to give students more control over the content of their learning activities. Finally, the 'traditional' schools designed ICT-enhanced learning arrangements that enabled differentiation with respect to cognitive aspects, while at the 'innovative schools,' differences in learning style and personal interests were facilitated by the use of ICT.

From these findings we conclude that the ICT tools, activities and goals in general reflected the different school concepts that set the school types apart. The findings also suggest that the 'traditional' schools developed less complex use of technology that seemed to be fairly easily implemented, while the 'innovative' schools designed rather complex use of technology, which seemed to hinder its implementation. This issue was further explored in the third and fourth study

The **second study** (chapter 3) focused on the interactive use of the interactive whiteboard (IWB), which was used in both school types, as the first study showed. One

of the distinctions between the two school types was the extent of the learner-centredness of teaching in the schools, i.e. the extent to which students had an active role in their learning process. This distinction was also expected to be visible in the interactive use of the IWB. This led to the main research question for this study: What types of classroom interactivity does the IWB support in 'traditional' and 'innovative' schools that develop their ICT use in a concept-guided way?

Two 'traditional' and two 'innovative' schools were included in this study. Video-observations of three lessons per school type were analysed. We focused on whole-class interactions between teachers, students and the IWB. This type of interaction was most prominent in the IWB-supported lessons that were observed and could therefore be compared most meaningfully. The analysis distinguished between the operation of the board, control of the content on the board and the type of classroom dialogue while using the board.

In the lessons at the 'traditional' schools the most common interactivity pattern found was teacher operation of the IWB together with teacher-controlled IWB content and dialogue that focused on knowledge transmission. Thus far the interactivity seemed to fit the 'traditional' concept. However, patterns that could be characterised as more 'innovative', with a more active student role, were found at the 'traditional' school as well. Similarly, even though the educational concept of the 'innovative' schools would suggest an active role for students in all respects, in most episodes a shared control of the content on the IWB was combined with operation of the board by the teacher. Therefore we conclude that although distinguishable patterns of interactivity characteristic for the two school types were found, the IWB-supported interactivity with regard to the active role of students was not always in line with what could be expected based on the schools' educational concepts.

In the next two studies, Part II of this dissertation, our focus shifted to the integration of the developed technology use, i.e. the extent to which the developed technology use became an integral part of the classroom practices of the teachers involved in the studies. An indicator for technology integration that is often used is the quantity of use, like the number of computers available to students or the frequency with which

technology is used. In a quantitative assessment of ICT integration higher frequencies of use are generally associated with higher levels of integration (Mueller, Wood, Willoughby, Ross & Specht, 2008; Tondeur, Hermans, van Braak & Valcke, 2008). On the other hand we find studies that define ICT integration in a more qualitative way, focusing on the pedagogies that are being supported with technology. Some of these studies imply that technology can only be considered 'integrated' when it supports a specific type of teaching and learning, suggesting that the highest stage of technology integration is only found in a context of innovative, constructivist teaching and learning (Lim, 2007; Mueller et al., 2008; Sandholtz, Ringstaff, &Dwyer, 1997). A concept-guided approach to development of technology use calls for a more neutral qualitative definition that gives room to a variety of pedagogies ('educational concepts') in which technology use can be integrated. In the studies 3 and 4 we therefore chose to focus on the extent to which the teachers themselves perceived the technology as an integral part of their practices in our definition of integration. In order to describe the teachers' perceptions three semi-structured focus group interviews were held at regular intervals with teachers at all five schools during the project. At two schools a fourth interview was held one year after the project had ended. The focus groups consisted of two to eight teachers per school, depending on how many teachers participated in the development and/or the realisation of the learning arrangements at the school.

From the studies in Part I we concluded that concept-guided development led to concept-specific differences in technology use. To explore whether concept-guided development of technology use might also lead to concept-specific differences in the integration of the developed technology we formulated the following research question for our **third study** (chapter 4): How can the achieved integration of technology in 'traditional' and 'innovative' schools that develop their use of technology in a concept-guided way be characterised in quantitative and qualitative terms?

In this study the integration of the developed technology use into the teachers' classroom practices was studied at all five participating schools. For the quantitative characterisation of the integration we used descriptive data on all seventeen learning arrangements that were developed during the project. The results showed that the

'traditional' schools tended to use a smaller variety of ICT tools per learning arrangement than the 'innovative' schools. The numbers of computers per class (desktop and laptop) that were available across the learning arrangements did differ between the schools, but not between the school types. The number of learning arrangements that were abandoned or partly abandoned during the project differed somewhat between the school types, with slightly more learning arrangements being continued as designed at the 'innovative' schools. To qualitatively characterise the integrated technology use we looked at the perceived value of the technology use, as expressed by the teachers in the focus group interviews throughout the project. At all five schools the technology use in the learning arrangements that were continued was in general perceived as 'common' or 'automatic' and most of it also as 'indispensable'. Both with regard to specific tools, like the IWB, and to technology in general, the teacher remarks indicated that at all schools at least some of the tools and their applications were highly valued by the participating teachers. In all five schools some of the newly introduced technology replaced the non-digital materials while other tools complemented existing materials or tools. These findings suggest that a concept-guided approach can promote the integration of technology use in schools with different educational concepts both in quantitative and in qualitative terms. The findings did not show clearly concept-specific differences in the achieved integration.

In order for innovations to lead to the intended effects they need to be sustained over a longer period of time (Jerald, 2005; Waslander, 2007). We therefore returned to one 'traditional' and one 'innovative' school one year after the project ended for an in-depth case study. For this **fourth study** (chapter 5) we formulated two research questions. First we investigated: Which of the technology use that was developed during the project was sustained, i.e. was still visible in the school? This aspect of sustainability was referred to as 'longevity'. Secondly we investigated: Was the technology use developed further during the year after the project and if so: how? This aspect was referred to as 'progressive integration'.

The final two focus group interviews at each of these two schools, held at the end of the project and one year after, were used to answer these questions. Both in terms of

longevity and progressive integration the technology use in the learning arrangements at the ‘innovative’ school appeared to be more sustainable than at the ‘traditional’ school. At the ’traditional’ school one of the arrangements had been abandoned completely and in one of the partially sustained arrangements the abandoned element had not been replaced by other technology use. At the ’innovative’ school no arrangements or elements of arrangements had been abandoned without being replaced by other technology use serving the same purpose and two learning arrangements were developed further, while at the ‘traditional’ school none of the technology use was developed further. At the ‘traditional’ school the teachers expressed no specific plans for future development of their technology use. At the ‘innovative’ school the teachers showed a tendency to continuously keep an eye open for ways to enhance their teaching and to incorporate technology therein. The further development of the technology use seemed to be part of the usual development of teaching and learning at this school.

**Discussion of the main results and conclusions**

In this section the theoretical and practical contributions of the dissertation are discussed, as well as limitations of the studies presented here. Also suggestions for further research are formulated.

*Theoretical contributions*

The results contribute to the existing theory on the development and integration of classroom use of ICT by providing findings that different types of schools can develop and integrate a type of ICT use that fits their educational concept, when applying the concept-guided approach. We developed analytical frameworks that enabled us to study the ICT use in detail. The first study analysed the developed ICT use in terms of the tools that are used, the activities in which they are used and the goals with which they are used. It enabled us to identify subtle differences between the different ways in which ICT is used. Similarly, in the analysis of the interactivity in lessons with the interactive whiteboard (IWB) in the second study the distinction between the aspects ‘operation of

the IWB', 'control of IWB content' and 'dialogue', provided a detailed and nuanced picture of similarities and differences in the interactivity between schools with different school concepts. By providing these nuanced analyses of the developed ICT use in the context of different school concepts, these studies add to the findings from other studies that focus on the link between a school's ICT use and educational concept (Ertmer, 2005; Hermans et al., 2008; Zhao et al., 2002).

In Part II the third and fourth studies contribute to the literature on ICT integration. The findings from both studies suggest that concept-guided development of technology use can lead to integrated technology use in schools with different educational concepts. This supports earlier findings that minimising the distance between technology innovation and the school's educational practice promotes technology integration (Zhao et al., 2002) and the sustainability of this integration (Datnow, 2005; Jerald, 2005). The studies also showed that in cases where an innovation did not remain visible because it had been abandoned, it proved useful to also investigate why it was abandoned and whether it was replaced by something else that supported the initial goal of the innovation, i.e. whether the effort to innovate was sustained. Finally, the third study showed that the limited room for curriculum development by teachers in a strongly textbook-driven curriculum needs to be taken into account as a factor that may hinder progressive development of technology use in this type of school. In such a 'traditional' school with a strongly pre-structured curriculum there is little time and inducement for the teachers to take on the enterprise of continued development of a learning arrangement and of the professional development that is needed to do this (Huizinga, Handelzalts, Nieveen, & Voogt, 2014).

*Practical contributions*

Our conclusions provide schools with evidence that concept-guided development is a promising approach that can lead to ICT use that fits the school's educational concept and can become sustainably integrated into the school's educational practices. The studies in Part I particularly also provide schools and educational consultants with well-described examples of how the approach was carried out in five different schools and

the ICT use that was developed in the context of this particular project. The insights from both studies can help teachers and consultants to become more aware of the different meanings that seemingly similar goals for using technology may have in schools with different educational concepts. This can help teachers to make more conscious decisions about the goals they want to promote by using technology in their lessons, a skill that also needs to be addressed in teacher training courses (Tondeur, van Braak, Sang, Voogt, Fisser, & Ottenbreit-Leftwich, 2011; Uerz, Kral, & de Ries, 2014). Finally, the sustainable integration of the developed ICT use seems to be most likely to happen in schools where teachers have a more positive attitude towards the continued development of their ICT use. This implies that attention has to be paid to the innovative attitude of the teachers involved in the innovation which must in turn be understood in the context of the innovativeness of the school as a whole. Also, teachers need time to develop their own ICT use and to sustain this development. Providing teachers with this time may be a challenge especially for schools with a strongly textbook-driven curriculum

*Limitations and suggestions for further research*

In all studies two to five schools participated. This relatively small scale gave us the opportunity to investigate in detail the learning arrangements that materialised at these schools as a result of concept-guided development of ICT use and their integration into the teachers' classroom practices. Yet in order to verify these findings in the context of a larger number of schools with a wider range of educational concepts a more large-scale approach is needed. A limitation with regard to the sustainable integration of the developed technology use is that this was only studied in two of the participating schools and only from the teachers' perspective. Sustainability of the integration of technology use that is developed in a concept-guided way requires attention in future studies with a larger scale and from different perspectives. An aspect that has not been investigated in these studies is the extent to which the developed technology use actually improved the quality of the teaching and learning processes that it supported. More research is needed to investigate this aspect of concept-guided development of

technology use, as improving teaching and learning is the main goal of technology innovation in the classroom. It would also be interesting to further investigate under which conditions concept-guided development of technology use promotes sustainable technology integration. Not all factors mentioned in the literature could be included in these studies, such as the teachers' views and beliefs about technology at the outset of the project, possible tensions within the teams of teachers-as-designers and the role of the school leaders (Geijsel, Sleegers, Stoel, & Krüger, 2009; Huizinga et al., 2014; Thoonen, Sleegers, Oort, Peetsma, & Geijsel, 2011). Further research could provide more insight into these factors in the context of a concept-guided approach.

Finally, with regard to the 'traditional' school concept the limited room for curriculum development by teachers in a strongly textbook-driven curriculum needs to be paid attention to. In such a pre-structured curriculum there is little time for the teachers to take on the enterprise of continued development of a learning arrangement and of the professional development that is needed to do this. Future studies could shed a light on the challenge that concept-guided development of ICT use can pose in this type of school

**General conclusion**

In the four studies presented here we explored the technology use and its integration into teachers' classroom practices that resulted from a concept-guided approach to the development of classroom technology use in five primary schools. The studies have shown that concept-guided development of technology use can lead to distinguishable types of technology use in schools with different educational concepts. The developed technology use became integrated into the teachers' practices, although this integration was not necessarily sustainable. We therefore conclude that it is a promising approach that can help to realise the potential of classroom technology. Further research is needed to gain more insight into the conditions that promote the concept-guided development of sustainably integrated technology use, enabling schools to take full advantage of its benefits.