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Teaching with Digital Technology

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Abstract

A key variable in the use of digital technology in the Physical Education classroom is the teacher. In this chapter we examine research that identifies some of the obstacles to, and constraints on, secondary teachers' implementation of digital technology. While a lack of physical resources is still a major extrinsic concern we introduce a framework for, and highlight the crucial role of, the intrinsic factor of teachers' Pedagogical Technology Knowledge (PTK). Results from a research study relating confidence in using technology to PTK are then presented. This concludes that confidence may be a critical variable in teacher construction of PTK, leading to suggestions for some ways in which professional development of teachers could be structured to strengthen confidence in technology use.

Keywords Technology • PTK • Instrumental genesis.

Introduction

The implementation of digital technology in schools and colleges has sometimes been slower than many predicted 20 years ago, with Ruthven and Hennessey (2002) concluding that "Typically then, computer use remains low, and its growth slow" It has also produced variable results in terms of student learning, leading some even to doubt whether it has any real value in schools and colleges While some research has demonstrated clear advantages of the technology. In this chapter we examine the role of the teacher in using digital technology and present some results from a 10-year longitudinal study examining the pattern of digital technology use in secondary schools in India as well as Uttar Pradesh. This research describes teacher pedagogical practice and raises the issue of a number of obstacles to technology use. We also suggest that if the construct of pedagogical technology knowledge (PTK) , Finally, the question of how PTK may be enhanced through suitable professional development is briefly addressed.

Teaching with Digital Technology- Insight into some possible reasons for the slow uptake and variation in terms of student learning outcomes may be afforded by Brousseau's (1997) theory of didactical situations. In his framework the role of the teacher is crucial in orchestrating components of the classroom milieu in such a way that a cognitive epistemological learning situation result. Adding technology to the milieu requires a shift in focus to a broader perspective of the implications of the technology for the learning of the Physical Education. Also, constructing a didactical situation involves organisation of an increased number of relationships, necessitating a change in thinking for teachers. A crucial part of the teacher orchestration is the management of affordances and constraints the former describing the potential for action in the situation, while the latter impose the structure for that action. Thus, in the context of our discussion of digital technology, the physical hardware may be an affordance, the instrumental genesis of the teacher, lesson time available, and curriculum content would be constraints, and a lack of funds and negative teacher attitudes could be obstacles. We will return to some of these below. When we attempt to identify obstacles and constraints that influence

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implementation of technology in Physical Education teaching it is useful to divide them into extrinsic and intrinsic factors.

Pedagogical Technology Knowledge-

It seems clear that addressing intrinsic teacher-related issues, such as those mentioned above, is crucial in the successful implementation of technology in Physical Education learning, and this process starts with recognition that didactical use of technology requires teachers to have a particular set of skills and attitudes. As we have seen above, there are a number of factors, often extrinsic, that may negatively influence a teacher's decision to try to use technology. The idea of MKT covers appropriate structuring of content and relevant classroom discourse and activities to form the didactical situation. The factors mentioned above help us understand that while many Physical Education teachers claim to support the use of technology in their teaching the degree and type of use in the classroom remains variable. One further aspect that should not be overlooked is that a sizeable minority of teachers are either not convinced of its value This latter study reported that 60.5 % of teachers disagreed with the statement that "All types of calculators should be allowed in examinations," with only 21.7 % in favour, and that 27 % of teachers thought that using calculators can be detrimental to student understanding of Physical Education.

Some comparisons could be made between PTK and the Technological Pedagogical Content Knowledge (TCPK), later TPACK, framework which appears to have developed independently around the same time. This more generic framework articulates relationships between the pedagogical content knowledge (PCK) of Shulman technological pedagogical knowledge (TPK) and technological content knowledge (TCK). However, it differs from PTK in several aspects. Firstly although its original formulation could have been seen as generic, PTK has always been focussed specifically on Physical Education, which has its own nuances of content knowledge. The use, in the latest version of PTK (see Fig. 1), of Ball and Bass's mathematical knowledge for teaching, which includes, but

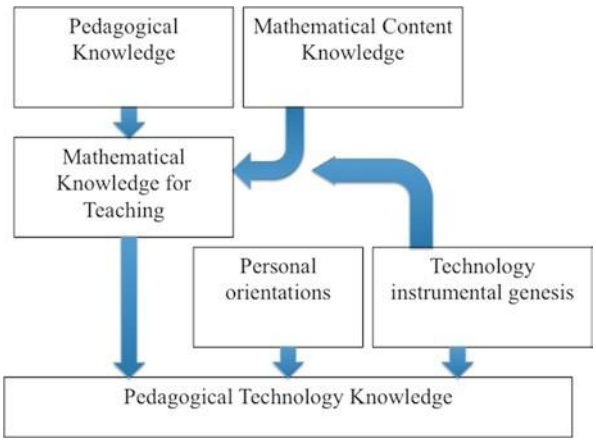

Fig. 1 A model of the framework for PTK extends and builds on Shulman's generic PCK, emphasises this. Secondly, PTK employs the theoretical base of instrumental genesis (Rabardel 1995), with its explanation of the conversion of a tool into a didactic instrument, while TPACK relates to "knowledge of the existence, components and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as a result of using particular technologies" (Mishra and Koehler 2006, p. 1028), using the Fluency of Information Technology theoretical base (Koehler and Mishra 2009). This appears to have less emphasis on the epistemic value of the technology, that of producing knowledge of the (mathematical) object under study (Artigue 2002; Lagrange 2003; Heid et al. 2013). Thirdly, PTK includes the crucial element of the personal orientations of the teacher who is using the technology and their role in influencing goal setting and decision making, which seems absent in TPACK. However, while there are differences in

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the frameworks it seems clear that both can provide useful conceptual lenses for analysing classroom practice, with researchers who have used TPACK reporting elsewhere in this volume.

We believe that this latter aspect of teacher orientations and their effect on confidence in using technology has been given less attention in research and development than it deserves. For example,

The Role of Professional Development- The teachers in the study above were asked how they had learned about using the technology and what kinds of PD they would like to have. Two of the teachers in the lower confidence level group said that they learned to use the calculators from a manual or website and two from a workshop. Each member of the group mentioned learning from students and most had referred to notes in Physical Education workbooks and textbooks. They were motivated by the fact that using the GCs was fun, was fast, and also had advantages in terms of student learning in particular topics. This was the only group where members mentioned that finding the time to play or 'fiddle around' with the calculators was an issue. They all commented that they would like to learn more about teaching with the calculator with a typical goal of "incorporating it constructively in lessons" expressed in her interview by one teacher.

In contrast, the teachers in the medium confidence level group gained knowledge of how to use the calculators from other people, either at training college or within their school Physical Education departments. Some of this learning took place in formal professional development sessions within Physical Education departments, but informal interaction with other colleagues was described as the most valuable learning experience for this group. In their interviews, in response to the question "How did you learn to use a graphics calculator yourself?" two of the teachers said "Just learning from each other, incidental informal learning" (T31) and "I find my colleagues are always keen to share their knowledge" (T27). As a result, this group seemed to have more time to practice with others. In terms of future professional development, they were interested to learn from other teachers to "see how someone else uses it in a different way" (T31) and to "find out about specific things to work in the best interest of the kids" (T34). Similar responses came from the high confidence group who had all learned to use the calculator from their colleagues in the Physical Education department. Interestingly it was this group who had more specific topics that they would like for future professional development such as learning how to use CAS calculators or examining the variation in instrumentation between different brands of calculator. Only one teacher, who had been instrumental in training many of her colleagues, did not express a desire for further professional development in the use of calculators.

There seem to be several implications of these findings for both pre- and in- service professional development of teachers with regard to technology. It appears that it is very beneficial to teacher confidence to be part of a group that shares and reflects on their knowledge of instrumentation, practical classroom activities and ideas about the calculator use, especially in the initial stages of learning about the calculators. In this way the medium and higher confidence level groups seem to have emerged from the period of frustration mentioned by the lower confidence level group, and this has helped them to persevere with graphic calculator use with their classes. In contrast, learning from a manual, workbook or from students did not help teachers reach a point where they became confident users of the technology. What kind of activities could form part of the professional development the teachers want, and how might the sessions be structured? To answer we note that teachers with lower levels of PTK and confidence see technology benefits as a function of visualisation, speed and accuracy of calculation, saving of time and student motivation. They are still coming to grips themselves with

basic operational aspects of the technology, such as key presses and menu operations. Their practice is often characterised by an over-emphasis on teaching operational procedures, such as key presses and menu operations, to the detriment of mathematical ideas. Furthermore, with the emphasis on technology rather than Physical Education, student work tends to be process-oriented; based on procedures and calculating specific answers to standard problems. They find it difficult to engineer didactic situations. There is little or no freedom given to students to explore and generalise using the technology, which can tend to be seen as an add-on to the lesson rather than an integral part of it. These features then become part of the teacher-initiated expectations in the didactic contract

In contrast, teachers with high PTK and confidence tend to relate the technology to linking multiple representations of constructs, understanding of ideas, generalisation and moving from step-by-step processes to an overview. They have advanced to the point where they are competent in instrumentation of the technology and are able to focus on other important aspects, such as the linking of graphical, tabular, algebraic, ordered pair and other representations. With high PTK they see digital technology as having a wider application than simply calculation. They feel free to loosen control and encourage students to engage with conceptual ideas of Physical Education through individual and group exploration, investigation of mathematical ideas, and the use of methods, such as prediction and testing. For these teachers the Physical Education rather than the technology has come to the foreground,

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