TPACK Analysis of Communities of Practice: The Context of the Norwegian Knowledge Promotion Curriculum Reform

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Abstract: This article presents three cases from the Norwegian national project "Learning Networks" to illustrate the challenges met by teachers trying to implement educational technology in their teaching. The Knowledge Promotion (K06) is a national curriculum reform. The goal of this reform is to help all students to develop fundamental skills that will enable them to participate actively in our society of knowledge, including the ability to make use of information and communication technology. This basic skill has been incorporated into all subject syllabuses through year 6-18. The analysis of the cases is carried out within a single theoretical framework; TPACK (Technological Pedagogical and Content Knowledge), which brings to light the interaction between three central knowledge areas for the teacher: content knowledge, pedagogical knowledge and technological knowledge. Experiences from *Learning Networks* show that a successful implementation of the Knowledge Promotion requires technological pedagogical content knowledge in all areas of the educational system.

Digital media are an intrinsic part of the lives of children and youth (Buckingham 2007; Luckin et al. 2008). The Knowledge Promotion defines basic skills as the ability to express oneself orally, the ability to read, the ability to do arithmetic, the ability to express oneself in writing and finally digital literacy as "the fifth area of basic skill". The reform aims to obtain a use of technology that is an integral part of disciplinary teaching. Recent research shows that most schools have access to the necessary technology (Ottestad 2008). However, few teachers use information and communication technologies (ICTs) as expected by the Knowledge Promotion (Arnseth et al. 2007).

Projects aimed to increase ICT literacy among teachers have characteristically been "lighthouse projects" or national projects aimed to increase the teachers' technical skills through in-service training courses. Those have not necessarily contributed to provide schools with a broad ICT literacy, as the training was often unconnected with the teachers' daily practice. The national project Learning Networks was set up in order to strengthen the implementation of ICT in schools through communities of practice. The project brings together teachers, school management, school district management and teacher education institutions, who work together towards implementing the fifth basic skill – the ability to make use of information and communication technology. By including the ability to make use of ICT in the new curriculum, and defining it as equal to the other basic skills, the

Norwegian government has recognized the importance of the development of skills for the 21th century. All teachers are therefore responsible for enabling students to develop basic skills through their work in various subject-areas.

In this article, we present three examples of development projects carried out within the realm of the project *"Learning Networks"*. We use the TPACK model to cast light onto the relationship between the various areas of knowledge in the different cases. Such a model can be useful in outlining the complexity of the demands made on teachers and in identifying the various elements that affect teaching practice in schools. It does not aim to provide an exhaustive description of a complex reality, but can possibly help to provide an understanding of it, which can form the basis for future developments.

TPACK: A Short Overview

At the beginning of the 1980's, Lee Shulman initiated and conducted a research project entitled "Knowledge growth in a profession" at Stanford University. Shulman (Shulman 1986; 1987; 2004) argued for the need of a new perspective within educational research which included a focus on the disciplinary content in schools - "The Missing Paradigm". The empirical data gathered from this project contributed to the development of a Knowledge base illustrating the complex knowledge of teachers. Although those seven categories are considered to represent essential areas of knowledge for a practicing teacher, it is highly probably that teachers have knowledge in other areas (Wilson 1988). Shulman argues that the most central area of knowledge is the construct Pedagogical Content Knowledge (PCK), which differentiates the teacher from the expert (Shulman 1987).
In recent years, several researchers (Engelien; Engen, Giæver & Bjarnø 2008; Ferdig 2006; Harris 2008; Koehler, M. J. & Mishra, P. 2008; Margerum-Leys 2001; Mishra & Koehler 2006; Niess 2005; Pierson 2001; Suharwoto 2006) have expanded on Shulman's construct of PCK to include teachers' use of technology as an important knowledge area. In understanding with Shulman's emphasis on PCK as an amalgam of content knowledge and pedagogy, TPACK (Technological pedagogical and content knowledge) is the amalgam of PCK and technology. *"True technology integration is understanding and negotiating the relationships between these three components of knowledge."* (Koehler, M. & Mishra, P. 2008).

In this context, knowledge is understood as *"a multitude of different ways of knowing, including knowledge, belief, disposition, and skill."* (Wilson, 1988) Research has demonstrated that many teachers only start to use ICT if they can use the technology in accordance with their existing beliefs and practices (Veen, 1993 s.139) (Ertmer 1999). These results have implications for projects that seek to contribute to teachers' development of TPCK.

TPCK represents a type of knowledge that teachers apply in their practical use of ICTs. All teaching situations consist of a web of different factors, and there is no straightforward technological solution that is applicable to all teaching situations. TPACK as a theoretical framework has bloomed over the last few years as it proposes a structured way to approach the complexity of ICT and learning (Cox 2008; AACTE 2008). In this article, the TPCK model is used to explain how complex objectives can be segmented, worked out in detail and brought together again.

Case 1: Challenges in interdisciplinary collaborative work and use of WIKI

The project described here aims to support the implementation of one of the competence aims outlined in Knowledge Promotion, namely the students' ability to relate to uncertain knowledge, evaluate the environmental aspects of consumption choices and energy use, as well as describe conflicts of interest at a global level. The use of wiki should support students and teachers in their teamwork and common knowledge development. The project was carried out in late 2007 and early 2008 in a first-year class in high school. Its aims consisted in:

- Developing an interdisciplinary collaboration between the three disciplines Norwegian language, Natural Sciences and Social Sciences within the realm of sustainable development
- Providing teachers and students with an experience of using wiki as a pedagogical tool
- Providing students with a knowledge of wikis
- Activating the students, giving them the possibility to create knowledge for each other,
- Training students to collaborate towards a collective product
- Avoiding "copy and paste" solutions

- Allowing students to develop their critical assessment skills as far as information sources are concerned, as well as teaching them proper referencing.

TPACK analysis of the case study

The teachers mostly agreed on the purposes of the project. However, they had different approaches to how to achieve those goals. Those differences had partly to do with their understanding of the notions of knowledge, pedagogy and technology (Ertmer 2005).

Content knowledge

There were significant differences among the teachers as far as knowledge and skills were concerned. The Natural Sciences teacher was interested in promoting the students involvement and appropriation of the content so as to achieve deep insights in the subject area. He was not particularly satisfied with the outcome of the project with regards to the students' content appropriation.

The Social Sciences teacher was also eager to get the students deeply acquainted with the content, and made it clear that the students needed to learn how to consider an issue from different perspectives and to discuss those. She was also dissatisfied with the outcome of the project in terms of the students' appropriation of the social sciences content. She suggested that part of the problem was due to her own knowledge of the topic which was not as extensive as she would have wished it to be, and to the fact that she had been absent for much of the project period.

The Norwegian language teacher had a markedly different outlook on knowledge. His understanding was that Norwegian as a subject was primarily a tool for other subjects and expected the wiki-project to provide the students with a certain type of methodical understanding and help them to acquire scientific thinking. He therefore expected a greater amount of collaboration across subject areas, and deplored the fact that assignments ended up being less open that he had hoped for. He saw the project as a useful process, and was less interested in the students' final production.

Pedagogical knowledge

The Natural Sciences teacher was keen to provide a new framework that would encourage student activity. Proper referencing also played an important part in the project. The teachers did not reach full agreement as to how much they would involve themselves with structuring the project. The Natural Sciences teacher considered the students as too immature to deal with an open project while the Norwegian language teacher was a proponent of presenting the students with open issues within a set framework.

Technological knowledge

Technology-related challenges did surface, although they were not the main source of disagreement. The Natural Sciences teacher was opposed to having the wiki discussions accessible to the general public. Both he and the Norwegian language teacher experienced that the students had trouble dealing with multimodal elements such as pictures and videos in the wiki. The latter also deplored the lack of flexibility in the wiki as far as layout is concerned. The Social Sciences teacher felt that there was too little structure in the pages and too many hyperlinks. It seems that the dissents that developed over time between the teachers were exacerbated by the use of the wiki tool. For the students, however, the wiki tool appeared to be a cementing element that helped give a direction to their work.

Overlapping goals between the different knowledge areas (TPCK)

The wiki resource supports important aspects of knowledge building (Scardamalia & Bereiter 2005), as it provides students with a way to share, save and further develop textual knowledge. Among the goals of the project was to give the students an opportunity to take initiative and responsibility, as well as formulate a problem and collaborate with others. Such goals are related to the processual aspects of the project and tended to clash with the product-oriented goals of the project.

The technology was in some way enabling and in other ways hindering the students in achieving their learning goals. It contributed to giving a greater place to the aspects of the project that were related to natural sciences and marginalizing the other subject areas. The use of the wiki rendered disagreements between the teachers more visible and has contributed to foster a discussion on pedagogical approaches.

Case 2: ICT in a vocational in-depth study project, Health and Social Care

Vocational education programs are a part of the Norwegian high school system. Workplaces such as primary schools, kindergartens, nursing homes, etc. are used as additional learning arenas for these students which part take in a Health and Social Care in-depth study project. It has been decided at the district level that all high schools in the County should use a particular virtual learning environment (VLE) both at school and during placements in professional contexts.

A complex situation

Teachers for the Health and Society specialization track have to relate to a number of dimensions that can be found in the TPACK model:

- relevant profession-oriented content (C)
- structures for learning and development both in school and at workplaces (P)
- evaluation of learning at various workplaces (P)
- technology related to content and learning processes (T)

An additional dimension in such projects is collaboration in an extended community of practice (Lave & Wenger 1991).

Professional pedagogical content knowledge (PCK)
As a result of the Knowledge Promotion, the teachers need to define a local syllabus for each subject discipline as well as a strategic plan for each student. This requires knowledge about different pedagogical models and insight into each student's career ambitions and professional interests. Teachers and professionals at the workplaces will then collaborate to provide the students with a work environment and work duties that can offer the best learning opportunities.

The use of technology in the specialization project (TCK)
It is expected that technology is integrated in all disciplines, including the specialization project which presupposes that teachers have knowledge about the integration of digital tools (both profession-specific tools and communication tools) in professional practice. Digital tools at the workplace are generally different from those used in schools. The Learning Network project focused on the use of VLEs to document students' work in all disciplines. This was motivated not by the relevance of the content or method, but by the school district requirements of VLE use.

Pedagogy and technology (TPK)
Learning adapted to the students' needs is central to the specialization project. The teachers therefore need to have knowledge in how technology can best support collaboration with workplaces and have insights into:

- the VLE's potential and limitations,
- various types of mobile solutions for documentation
- workplace capacities and competence in terms of technology-based collaboration
- alternative internet-based collaboration forms

In the planning, implementation and evaluation work for the project, important issues need to be raised as far as the usefulness and user friendliness of VLEs for the students and for their mentors at the workplace.

An extended community of practice

During the specialization period, students have mentors both at the school and at the workplace, and the latter do not necessarily have the knowledge and skills to implement different pedagogical models, the use of VLEs and other technologies, or even mentoring. VLEs are generally not used at workplaces outside collaboration with schools.

They therefore represent a sometimes unwelcome addition to the routines already in place at the workplace. Use of VLEs appears sometimes to be artificial, and to take the focus away from the real work duties that the student has to immerse him or herself into.

Case 3: From National curriculum to school practice: development of local plans

The Knowledge Promotion requires that schools can provide a high standard environment for the students' use of digital tools and that the basic skill of digital literacy is incorporated into all subject syllabuses at all levels. This has to be translated into achievable goals, and this case study outlines how this process was carried out by one particular school district.

The process

The Knowledge Promotion was analyzed in depth, and the relevant ICT skills were identified in five main areas, which were discipline independent:

- text production
- use of numbers
- digital pictures
- digital sounds
- ICT knowledge, information and communication

The intention was to indentify the skill requirements at each grade, and make it easier to control that the goals are reached. Focus groups, consisting of representatives from each school in the district, worked towards defining which digital skills were applicable to the different grades in primary and secondary school. It is worth to note that the school district took the paradoxical stance to focus on discipline-independent ICT skills while the Knowledge Promotion focuses on the integration of ICT in all disciplines. This decision will necessarily have consequences, which are worth investigating.

Our understanding of TPACK

The Knowledge Promotion, in requiring the integration of ICT in all subject disciplines, demands that teachers have a general competence that encompasses disciplinary knowledge, technological knowledge, pedagogical knowledge and insight to how those three areas are to be related with each other in a meaningful way. In that respect, the teacher qualifications required by the Knowledge Promotion are one and the same with the very core of the TPACK model – the technological pedagogical content knowledge. The Knowledge Promotion aims to a systematic use of ICT as an integral part of the students' total learning path. Schools therefore need to develop knowledge about the relationship between technologies, pedagogy and content at all the levels of their organization.

TPCK analysis

The five basic skills described in the Knowledge Promotion represent the pedagogical bedrock (P). The use of digital tools in school is a complex competence that includes pedagogy and technology (TPK). The various syllabuses represent the disciplinary content (C), but also include elements of pedagogical content knowledge (PCK).

Although the curriculum plans of Knowledge Promotion is ideally method independent, it does propose a range of methods for the integration of ICT in disciplines (TCK). The integration into disciplines makes it difficult to crystallize the basic digital literacy skills and for that reason the measurement of achieved goals. In this process, there is a shift in focus from seeing the use of ICT as an integral part of subject teaching, to a focus on implementation of technical skills (TCK -> T). On the one hand, this may look like a retreat as far as the integration intentions are concerned. On the other hand, it allows for a clearer overview of the skills that are needed to achieve a comprehensive and progressive integration.

The Knowledge Promotion has also other learning goals that are ICT related. The potential for ICT use in various subject areas can only be uncovered if the teachers have a comprehensive and compound knowledge (TPACK), building on all three knowledge areas. As Mishra and Koehler state: *"Effective technology integration for*

pedagogy around specific subject matter requires developing sensitivity to the dynamic, [transactional] relationship between all three components." (Koehler, M. & Mishra, P. 2008).

The main areas of ICT (T)

The goals in terms of ICT skills (T) were discussed in the focus groups and situated in a pedagogical context (TPK). This resulted in specific objectives in terms of ICT skills to be acquired by students, for each grade (1-10). Those objectives are discipline independent, which means that the schools have much freedom in choosing how they are to be implemented. In some cases, skill-oriented training where each student carries out assignments on a computer can be chosen. In other cases skills are acquired as an integral part of discipline-oriented work. In any case the schools have clear objectives and clear methods to assess whether the standards have been reached, in particular in form of a "contract" between the students and the school.

Summary

It has been challenging to find a way to translate the intentions of the Knowledge Promotion into specific goals, but this has been performed successfully with an implementation and evaluation document that focused on organizational knowledge rather than individual knowledge (organizational TPCK). Another challenge resides in the capacity of the focus groups to contribute to the implementation of these standards by achieving wide participation and involvement in the district schools.

The experience acquired from this school district project has raised considerable interest among other schools. Several school districts have started similar projects and elaborate on the knowledge and experience from this project in their own development of standards.

Conclusion

The "Learning Networks" projects are managed by the teacher education institutions, which provide dynamic communities of practice that allows for the sharing of knowledge and experience. The project has allowed for reflection and knowledge development around the issue of technology use in schools. It is apparent from the analyses above that TPACK has been a useful framework to help understand the complexity of the demands made on teachers. It is this situated and dynamical knowledge area at the core of the model that will bring about good practice.

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