PERSPECTIVES ON TEACHERS' PROFESSIONAL DIGITAL COMPETENCE

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Abstract

This ongoing research aims at gaining increased knowledge on how to investigate the understanding and development of digital competence as a transdisciplinary learning process in teacher education. In this paper, we employ three promising conceptual frameworks for understanding teachers' digital competence to analyse a small set of empirical data. The three different approaches include Davies's [1] framework of technology literacy, including awareness, praxis and phronesis, Krumsvik's [2] model for self-awareness and practical proficiency and Mishra and Koehler's [3] Technical Pedagogical Content Knowledge (TPACK) model, including technological, pedagogical and content knowledge as well as contextual knowledge. The initial analysis demonstrates the analytic strength of the three approaches. However, we recommend further investigation into the strengths and weaknesses of these frameworks before giving any further advice regarding their employment in teacher education research.

Keywords: Teacher professional digital competence, teacher profession, digital competence.

1 INTRODUCTION

While teacher education programmes include a large variety of subject areas, they lack coherence and a common vision. There is a need to gain insight into transdisciplinary learning processes, such as the development of digital competence, to understand how teacher education programmes can secure professional competence that can meet the future needs of society.

The understanding of teachers' professional digital competence is under continuous investigation [4] [5] [3]. The research has focused on what constitutes such competence, how to measure such competence and critical perspectives on the prevalent understanding of the epistemological and ontological understanding of teacher qualifications in the digital age.

Several definitions and frameworks describe the concept of digital competence using operational digital skills/digital literacy, such as 'the ability to search, choose and share information'. However, 21st-century skills are striving to define future competences in terms of generic skills, such as the 'four cs': creativity, communication, collaboration and critical thinking. It is therefore interesting to investigate in what ways different conceptual frameworks describing digital competence have the strength to illuminate all aspects of teachers´ professional competence.

1.1 Three Conceptual Frameworks

In this paper, we employ three promising conceptual frameworks for understanding teachers' digital competence to analyse a small set of empirical data. The three different approaches include Davies's [1] framework of technology literacy, including awareness, praxis and phronesis, Krumsvik's [2] model for self-awareness and practical proficiency and Mishra and Koehler's [3] (updated by Mishra [6]) Technical Pedagogical Content Knowledge (TPACK) model, including technological, pedagogical and content knowledge as well as contextual knowledge. The three approaches represent quite different perspectives for understanding and analysing teachers' professional digital competence, as described below.

1.1.1 Framework One: Awareness-Praxis-Phronesis

In this framework by Davies [1],t hree levels of technology literacy are emphasised. A taxonomy from low to high proficiency describes the three levels, beginning with awareness. At this level, teachers need to be exposed to technology, and they should develop declarative knowledge of Information and Communications Technology (ICT) [7]. The next level, praxis, is when teachers develop procedural knowledge as they become familiar with the customary use and functionality of the technology [7]. The

most prominent level, phronesis, combines practical competence with practical wisdom (i.e. students have become adept at using technology). Students have conceptual knowledge and show reflective practice [7].

Levels of Technology Literacy

Literacy Level		Type of User	Usage Level
Awareness	Functionally illiterate Limited literacy	Non user Potential user	None/resistant Limited
Praxis	Developing Experienced	Tentative user Capable user	Guided/directed Bring it on
Phronesis	Practical competence Practical wisdom	Expert user Discerning user	Power Selective

Table 1.

Characteristics of Users at Various Levels of Technology Literacy

	Typical Activity	Literacy Question
Awareness	Hear about new technologies Learn of capabilities of new technologies	What can it do?
Praxis	Practice customary implementation Explore/attempt variety of applications	How do you __? Do you? Are you?
Phronesis	Effective use of technologies capabilities Discerning/appropriate use of technologies	Why are you?

Table 2.

Figure 1: Awareness-Praxis-Phronesis, framework from Davies [1].

1.1.2 Framework Two: Practical Proficiency and Self-awareness

In this framework, Krumsvik [2] combines two strands. The first strand, practical proficiency, can be used to illustrate the teachers' practical competence journey, from low to high levels (e.g. adoption and adaptation to appropriation and finally innovation). The determination of proficiency levels is based on how teachers handle technological artefacts, their use frequency and their know-how in terms of tacit and explicit knowledge. The second strand, self-awareness, can be used to illustrate the teachers' mental digital competence journey as they develop from low to high awareness (e.g. adoption and adaptation to appropriation and finally innovation). It takes time for a novice to develop from being technophobic into an expert user. Together, these two strands can be used in a diagram, with self-awareness as the vertical axis and practical proficiency as the horizontal axis. In combining these strands, Krumsvik [2] presents basic digital skills, didactic ICT competence, learning strategies and digital building as combinations of practical proficiency and self-awareness. Based on classifying the teachers' adoption, adaptation, appropriation and innovation of ICT, it seems applicable for determining the teachers' journey, from having basic digital skills to digital building.

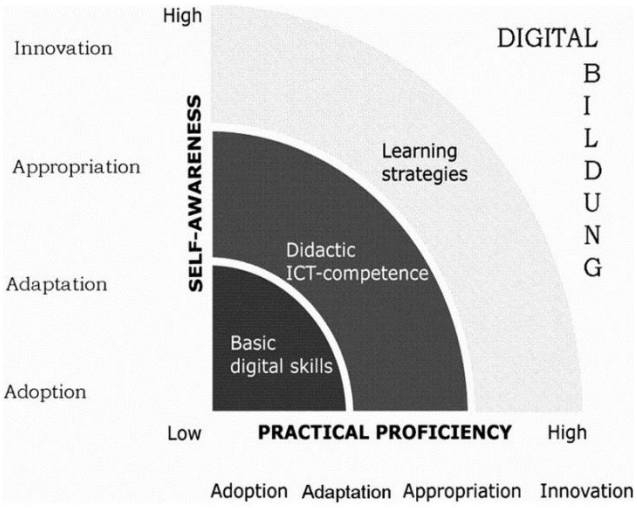

Figure 2: Practical proficiency and self-awareness, framework from Krumsvik [2].

1.1.3 Framework Three: TPACK

This framework is based on the concept of Pedagogical Content Knowledge (PCK) [8]. In their framework, Mishra and Koehler [3] added the term technology to the PCK framework and developed a model that contains three primary forms of knowledge: Content Knowledge (CK), Pedagogical Knowledge (PK) and Technological Knowledge (TK). These three forms are dependent on and mutually influence one another. It is therefore necessary to scrutinise the relationship between these forms through four intersections: PCK, Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK). This paper emphasises the latter three intersections. TCK is how students show knowledge of combining class content with technology. TPK is how students are able to use technology through their instruction to ensure good teaching and learning. TPACK depends on the overlap of TPK and TCK (e.g. the relevant technology must be chosen and used in a way that supports students' understanding of the content).

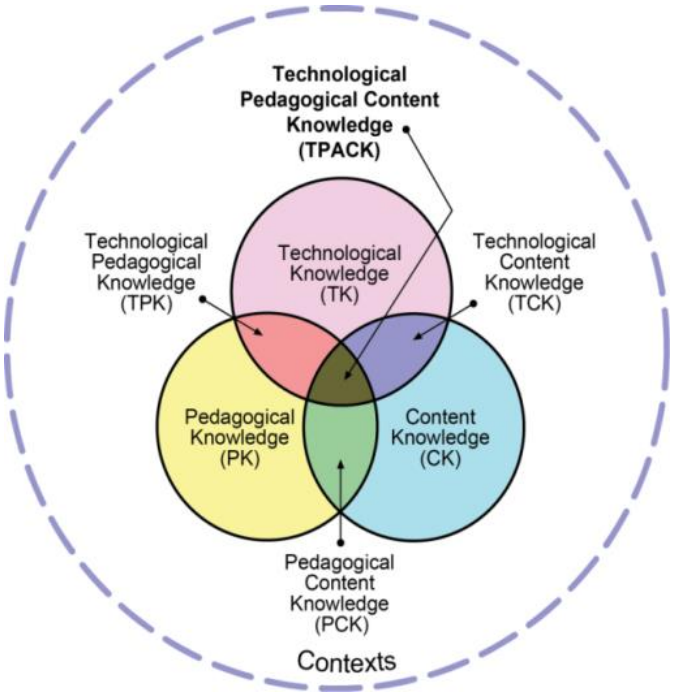

Figure 3: TPACK, framework from Mishra & Koehler [3].

2 METHODOLOGY

In our study, four student teachers were observed during their teaching practice in a primary school. The students were also interviewed regarding their ideas of digital competence, what they need to know to manage their practice placement and the relevance of the digital competence that they have gained from the teacher education programme.

3 RESULTS

From the observation of the student teachers, several interesting cases emerged as candidates for investigating the strength of the three presented frameworks. The two cases below were chosen because they are interesting in terms of being related to the use of digital tools for teaching and learning:

1. A student teacher used a video to instruct students in the use of a professional drawing software in Art & Design (A&D).
2. Student teachers used video recordings to demonstrate the practical use of sewing machine training.

Clearly, we need to have a particular awareness of the two levels of technology use in these cases: that of using a technological tool (drawing software/sewing machine) and that of using digital tools (video, screen cast, video screen, tablets, etc.).

3.1 CASE 1: A student student teacher using a professional drawing software for A&D teaching

The student teacher was in charge of a series of sessions that aimed to train students in the use of a drawing software as part of the A&D curriculum for the 7th grade. She chose to use a specific software with which she had previous experience as a professional designer. The session that we observed built upon a previous session that had occurred a few days earlier. To prepare for the class, the student teacher used a screen-cast programme to capture a demo video of the process of transforming a circle into a bullet and making it appear in the air, casting a shadow. From previous sessions, the students had learned how to make a circle on a background. The demo video was made available to the students via iThoughts—a software for planning and distributing learning material—on tablets.

The student teacher presented the procedure from the blackboard. While the students were working with the same software on their tablets, she demonstrated what to do step by step. She explained how to use a particular kind of brush to make the circle look like a bullet by drawing on certain parts of the circle. Her explanation included that the students needed to make different layers of the drawings to avoid the brush painting outside the circle. She demonstrated the procedure, referring to the work from the previous session. However, her in-class demonstration experienced several technical problems that had not occurred when making the demo video, causing her to go back and start again several times. Although the student teacher remained calm, we observed several students struggling to complete the task on their own tablets and subsequently losing focus. The final part of the demonstration included how to make a shadow to make the impression that the bullet was floating in the air.

3.2 CASE 2: Practical sewing-machine training with a video

Practical training in the use of sewing machines is part of the curriculum for the 5th grade. A group of four student teachers worked together with the A&D teacher on this topic for some weeks. The student teachers wanted to make demo videos to demonstrate the use of the sewing machine. Before the class we observed, the student teachers had filmed the A&D teacher performing several tasks, such as threading, straight stiches and zigzag stiches, turning the fabric at a right angle, etc. To the best of our knowledge, the videos were made without advanced video recording technologies. The A&D teacher explained what she was doing both clearly and confidently. The videos were distributed amongst the students via file-share software on their tablets.

The student teachers began by presenting a photo of one of the school's sewing machines on a video screen and asking one of the students to explain how to thread the sewing machine by drawing it on the

screen/photo. This engaged students by having them repeat what they had learned previously via the videos and visualising the procedure before practicing on the machines.

Each student then started using a sewing machine to practice the assigned tasks by placing his/her tablet beside his/her sewing machine and following the instructions from the demo videos. When anything went wrong, the students could rewind the video to better understand and do it again. The student teachers supervised the session and used both the video and practical advice to help students fulfil the task.

Table 1. The Student Teachers' Professional Competence.

	Case 1: Drawing software	Case 2: Sewing machine
Framework 1 Davies (2011)	The student teacher seemed to be a tentative user but a potential instructor. She displayed declarative knowledge and demonstrated procedural knowledge. However, her reflective practice regarding how to use and demonstrate such advanced technology in an educational setting was low. Consequently, the student teacher's literacy level can be characterised as praxis.	The student teachers seemed to be experts in video development. They appeared to be capable instructors in terms of sewing. They demonstrated not only declarative knowledge of how to produce videos but also procedural knowledge on how to employ it and achieve the desired outcome regarding the process of sewing and reflective practice on the pedagogical strength of having videos to support practical training. Therefore, the student teachers' literacy level can be characterised as phronesis.
Framework 2 Krumsvik (2014)	The student teacher showed high self-awareness and high practical proficiency. However, when adding an instructional aspect, the student teacher's ability was moderate/low because she was not able to guide the pupils through more than the tool. The student teacher did not demonstrate didactic ICT competence.	The student teachers displayed high practical proficiency and self-awareness in developing a video and showing a picture of the sewing machine on a whiteboard. The student teachers did display didactic ICT competence.
Framework 3 Mishra & Koehler (2006); Mishra (2019)	TCK: The student teacher was not able to provide instruction in A&D (e.g. explaining the use of shadows to illustrate a 3D effect). TPK: The screen cast was relevant, and the pupils could watch the film several times. However, there was a discrepancy between the screen cast and the classroom instruction. This resulted in confusion among the students, and some students were	TCK: The student teachers were able to illustrate the machine on the whiteboard, and they presented a video to demonstrate sewing. TPK: The student teachers aptly combined technology with practical examples. The pupils were able to adapt the material to their own levels. TPCK: Based on the above, the student teachers showed a clear

	not able to follow and use the programme. TPCK: Based on the above, it is difficult to identify a clear connection between knowledge about technology, pedagogy and content.	alignment between knowledge about technology, pedagogy and content.

4 CONCLUSIONS

This ongoing research aims at gaining increased knowledge on how to investigate the understanding and development of digital competence as a transdisciplinary learning process in teacher education. In this initial analysis, the analytic strength of the three approaches is partly demonstrated. The framework of Davies [1] first and foremost focused on usage (awareness, praxis and phronesis), but pedagogical dimensions were not considered. By contrast, Krumsvik's [2] framework aims at both categorising the usage (adoption, adaption, appropriation and innovation) and the pedagogical use of technology (such as didactic ICT competence). However, to aptly characterise didactic use, the analysis of practical proficiency and self-awareness must include the pedagogical dimensions of what is analysed. Although the student teacher in case one was showing a high degree of self-awareness and a high degree of practical proficiency in using the drawing software, she did not show sufficient didactic ICT competence and contained no interesting learning strategies. Regarding Mishra and Koehler's [3] TPACK model, the pedagogical dimension of the technology use is immanent. However, the framework was developed to measure the student teachers' compound knowledge of technology, pedagogy and content (subject area); it is to a lesser degree focused on the actual usage.

Based on this initial research, we recommend further investigation into the strengths and weaknesses of these frameworks before giving any further advice regarding their employment in teacher education research.

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