



The Importance of Teacher Education in Coping with the Challenges of the Digitalization in Germany

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Abstract

We live in the midst of a digital revolution. Most people are connected to the Internet, using digital devices and services at work and in many aspects of their lives. There is also no doubt that the rapid development of technology has also massively changed the field of education in the last decades. Studies show that there is an apparent need for a massive change in the conventional teaching ways in different learning environments that support the acquisition of 21st century skills where the teacher has a prominent role in the digital transformation process. Moreover, teacher education plays a vital role in the hierarchy of a successful implementation of digital media in classroom learning and teaching processes. The use of digital media in schools on the other side is attributed to technical, subject-didactic and pedagogical potential, which promotes the acquisition of technical and interdisciplinary skills. Although digital education has become more critical over the last years in Germany, barely any progress has been made in the field of teachers' digital competency. This article will sharpen the view about conceptualizing digitalization as an emerging process in the teaching profession by embedding it in the interdisciplinary discourse. The ambiguity of the digitalization concept will also be cleared. In the interdisciplinary overview, a heuristic is offered that sheds light on the cross-phase cooperation in the teaching profession concerning digitalization related to the German teacher training that puts perspectives, conditions and processes at the forefront for its success.

Keywords: Competency, digital education, training, transformation, process

1. Introduction

Social change in a digitalized, networked and automated world and the transformation processes associated with digitalization go hand in hand with questions about the need and potential for systematic change, which, in addition to other areas such as economics and law, are also crucial in the field of education in particular. Digitalization in the teaching profession has received even more attention in science and public since the beginning of the corona pandemic. School as a place of formal educational processes has a special meaning for all children and young people. Its task is to systematically promote different modes of understanding and action in a digitalized world to provide orientation and counteract possible educational disparities. Teachers should integrate digital media into the classroom, reflect on the implementation in the classroom and prepare students for life in an increasingly digital world (Starkey, 2019). Digital change has also created new demands on society, schools and teacher training. The quality of teacher training can positively impact school development in the long term. The International Computer and Information Literacy Study 2018 (ICILS) made it clear that, in an international comparison, teachers in Germany still rarely use digital media in the classroom. As a result, the potential of digital media, such as multimedia representations and adaptive learning offers, or new opportunities for communication and collaboration should be more exploited in the classroom. In addition to the technical equipment, teachers need sufficient skills and a positive attitude toward digital media for successful media integration in the classroom (Knezek & Christensen, 2016; Petko, 2012). In order to implement this in the classroom, teachers should be able to combine technical, pedagogical and specialist knowledge (Mishra & Koehler, 2006). Educational sciences and subject didactics in teacher education can be essential in promoting these skills and building a positive attitude (Kay, 2006; Wang et al., 2018). On the other hand, university lecturers in teacher training courses and mentors in practical training phases play a vital role in acquiring these skills by prospective teachers and helping them to cope with the challenges raised by digitalization in the educational field. However, it has been mainly unclear what is meant by the term and subject matter of digitalization in the relevant specialist literature. This paper is therefore based on the following questions: What is meant exactly by digitalization and which prominent conceptual and subject-related connotations of "digitalization" in the teaching profession are available in the literature? Moreover, to which extent does teacher education play an essential role in coping with the challenges of digitalization? In order to be able to answer these questions, a concrete definition of the term will be presented across the national and international literature and its relation with the teaching profession (section 2). Moreover, in the third section, we will shed light on the current situation of teacher training across phases in Germany by presenting empirical findings on teacher education in the context of digitalization. In the fourth section, a heuristic is offered to promote cooperation across teacher education phases and its success. Finally, the paper concludes with a development prospect for the modern development of teacher education.

2. Clearing the ambiguity on the term of digitalization

2.1. Defining the term “Digitalization”

Despite the prominence of digitalization in connection with the teaching profession, it remains largely open not only in individual texts but also in the discourse as a whole. So, what is concretely meant by term and object. Loleit (2004), for example, sees an "almost unlimited connotative and thus also ideological chargeability" (p.209) for the popular language use. For the scientific language use of the word "digital," she states that:

"The technical denotative 'counting, numerically' [...] is displaced by the ideological connotation 'new' with any possible interpretation. [...]. The term digital here becomes a word shell, which, although grammatically itself attributive, literally absorbs the properties of the attached expressive nouns".

Even apart from the purely strategic or (educational) political use of the term, it can be stated that "digitalization" is a "convoluted term" (Whitacre et al., 2020), which is used ambiguously and whose connotations of meaning have to be differentiated in academic language use or whose exact meaning only becomes apparent in a specific field of discourse on the basis of the topics dealt with in detail. It seems essential to use the term and the object digitalization in the context of the teaching profession not only as a cipher, but under the precise definition, if this is not only to mark an (educational policy) innovation, but also if an object-related discussion is to take place. This requires examining perspectives and facets of the meaning of the term, pointing out lines of discussion to concrete objects and enabling a linguistic ability beyond the concept of container. This can strengthen awareness of the diversity or poverty of meaning and thus the avoidance of arbitrary use of the term digitalization, which can be framed in terms of professional theory in the sense of a meta-reflexive approach to the term and object (Cramer et al., 2019). In this way, voids in the discourse can also be marked, which come to light, for example, in comparison with the broader, cross-disciplinary discourse around digitalization.

2.2. Current definitions of digitalization in the teaching profession

In the context of advancing digitalization, education policy attaches great importance to the use of digital media and educational technologies in teaching. Digitalization is understood as a process of change in which digital media and technologies increasingly complement previous analogue teaching processes and allow new possibilities for the realization of learning and teaching processes (Chauhan, 2017). At the same time, however, the increasing digitalization also poses social challenges, which require a comprehensive media education of students.

When we talk about digitalization in the context of schools, it may be intuitively clear to everyday school teachers what is being discussed. This could explain why only recent publications have addressed the need for conceptual and representational clarity in the context of the teaching profession. Herzig (2020), for instance, sees two conceptual understandings of digitalization: a narrow one that refers to technical aspects of signal conversion and a broad one that concerns "the networking, sensorization, datafication, and algorithmization of society" and thus focuses on technology and its effect on society. A distinction should be made between

digitalization and "mediatization," which refers to "the enormous social change brought about by technical development" (Herzig, 2020) and is thus a consequence of digitalization.

Thus, the technical connotation itself is rather neglected and the consequences using technology are addressed. Consequently, the consequences of technical aspects are dealt with under the term mediatization or under the term digitalization. The aspect of the narrow definition of technical aspects and their facets addressed at the beginning is additionally addressed under the term digitality, when (Pietraß, 2020) understands digitality as "[the] generation of the possibility of what could be, i.e., the new quality of virtuality rightly attributed to digital media". However, this is also an ambiguous term: digitality can be used with a focus on processes induced by technology, for example, when Mayrberger (2020) understands digitality as "socio-cultural practices [that] evolve through the combination of digital and analogue praxis." Digitalization in the context of the teaching profession emerges as the term that takes up the connotations of mediatization and digitality: As an umbrella term, "digitalization" subsumes both "mediatization" and "digitality," as can be seen in the definitional work on digitalization (Rothland & Herrlinger, 2020). Digitalization appears to refer both to more technical aspects and to the societal and educational change associated with technical innovation. A first classification offer that takes up and identifies such conceptual distinctions is available as a result of a heuristic obtained from the literature across disciplines (Binder & Cramer, 2021), which can be used as a starting point for further sharpening the used term. The latter understands the aspect of social-school change as a process of control and/or transformation, which is reflected in aspects of technology, in (didactic) interaction, or in anthropological-social consequences. In this way, concretization and differentiation of the subject are achieved. It is necessary to examine to what extent these connotations identified across disciplines can also be used to sharpen the concept and object of digitalization in the available literature specifically on the teaching profession.

3. German teacher education in the context of digitalization

In recent years, teacher training in Germany has been characterized by reforms (as part of the "Quality Campaign for Teacher Training") with the aim of initiating innovation processes at universities, study seminars and institutions of further education and training and, thus, ultimately indirectly at schools. There has also been a prominent discourse on digitalization in the teaching profession for several years.

Teacher training is faced with the question of how to anchor the topic of digitalization in teaching degree courses. The question of the content and organizational location of digitalization in teacher training is primarily related to how we understand digitalization. Module handbooks and curricula of the various phases of training reveal gaps in this regard, that is why this section will look into the question of how teacher training (especially in the first phase) should be structured in terms of content and methodology in order to be able to impart the relevant skills: is it about providing future teachers with the conditions and convey a critical approach to digital technology? Is it about using the computer in subject lessons and school development? Or a more general concern with the implications of the digital from an

educational perspective? The following contribution would encourage the positioning of digitalization in German teacher training.

The following remarks should be prefaced by the fact that a training and further education offer can only be profitable if the heterogeneous interests, attitudes, preconditions and levels of competence of (prospective) teachers with regard to teaching and learning with digital media are taken into account (Farjon et al., 2019), and both technical competencies as well as general and subject didactical competencies for the use of new technologies are addressed (e.g., Nelson et al., 2019).

3.1. The first teacher training phase in the context of digitalization

University teacher training in the context of digitalization in Germany can be implemented through integrated compulsory courses, media-related study certificates, or supplementary courses (Herzig & Aßmann, 2014). However, media-related offerings in this area have so far only been available to a limited extent overall (Kammerl & Mayrberger, 2014) and, for the most part, do not have any binding anchoring of media education content in the study regulations. This, according to the authors, means that prospective teachers often continue to have an inadequately trained professional media competence, which then has an impact on the second then affects the second teacher training phase. Above all, topics such as media education and socialization, as well as school development with digital media, which are of central importance in optimizing learning processes and teaching quality, are not systematically addressed in university teacher training.

Accordingly, a large proportion of the teachers state that university teacher training should be more firmly on the use of digital media in the classroom (86%) as well as on promoting computer-related training of students (85.2%) (Eickelmann et al., 2016). It is also clear that the teacher training program still has little potential concerning the use of digital media, as so far, only one-fifth of the teachers state that their teacher training program leads them to look more closely at how digital media affect learning methods they use in the classroom. However, more in-depth analyses suggest that changes in teacher education are slowly becoming noticeable as younger teachers agree to a higher degree that they have dealt with digitalization-related topics in their studies (Lorenz et al, 2019).

3.2. The second phase of teacher education in the context of digitalization

The potential of the second phase of training can also be seen on the basis of international studies, primarily in the fact that the practical school experience of future teachers is a central predictor for the later implementation of digital media in their own teaching (Tondeur et al. 2019).

For the future teachers, there are, however, hardly any binding requirements in Germany that could ensure that the teacher traineeship or the preparatory teachers/ pre-service teachers are trained systematically and comprehensively in their professional media competence, so that the success of the training in this phase is strongly linked to the commitment of the respective trainers. For the second phase of training, however, more than four-fifths of teachers state that teacher training should prepare them more strongly for using of digital media in the classroom

(86.8%) and for promoting computer-related skills in students (84.0%). Similarly, the second teacher training phase does not lead a large proportion of teachers (73.4%) to look more closely at how digital media affect the teaching methods they use in the classroom (Bos et al., 2016).

3.3. The third phase of teacher education in the context of Digitalization

Against the background of rapid technological developments and the weak anchoring of corresponding offers in the first and second teacher training phases, professional learning opportunities are highly important. The relevance of this third phase of teacher education is also reflected in the fact that more than half of the teachers currently state that further training has prompted them to deal more closely with how digital media affect the learning methods used in the classroom (Bos et al, 2016). An international comparison clearly shows the need for action: In Germany, for example, not even one in five teachers (17.1%) has attended a course on integrating IT into the classroom. This result corresponds to the more recent results of the IQB education trends 2015. In the context of the 2016 country indicator, on the other hand, around two-fifths gave (41.9%) of the teachers surveyed offered further training on subject-specific lesson development with digital media or on active media work with students (41.1%) to have attended. The TIMSS 2015 school performance study (Trends in International Mathematics and Science Study) in Germany shows that at the primary level, a relatively low level of participation in further education is again significantly lower (Eickelmann & Drossel, 2018).

Overall, there are still comparatively few corresponding further education and training offers (Bos et al. 2016). In this context, it is striking that in the international comparative study ICILS 2013 (International Computer and Information Literacy Study) education systems that have performed well in digital education show higher participation in further education and training measures than recorded in Germany. Although the cross-sectional ICILS 2013 study does not show a causal connection between the performance level of education systems and participation in teacher training courses in the field of digitalization, there is a tendency that in the context of digitalization and against the background of technical and pedagogical opportunities, regular participation in appropriate training courses and further qualifications plays a major role.

In Germany, it can also be observed that school administrations make the use of digital media absolutely mandatory (Gerick et al. 2016), and training courses on their use of IT in the classroom hardly give priority. Nevertheless, in this context in-depth analyses also show that in Germany, it is given less prioritization from the school management with regard to other training offers, but rather the opportunities for acquiring didactic skills related to attending further training courses.

4. A heuristic view for teacher education

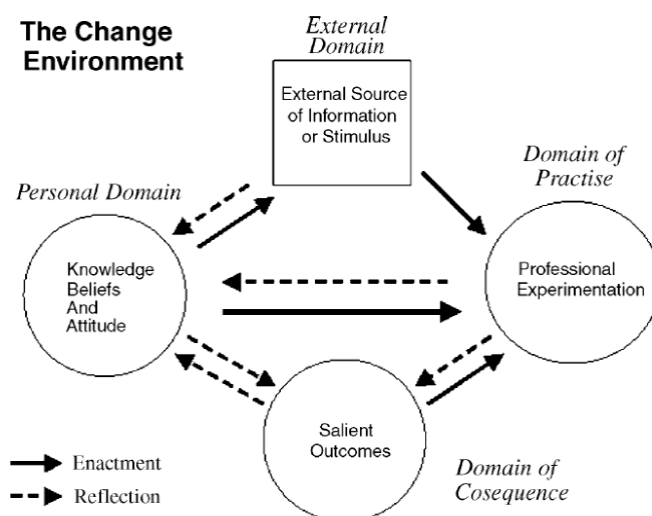
Training and further education stand out from the demanding task of preparing teachers for the many levels and facets of digital change in schools and classrooms. This task cannot be accomplished with a one-off training initiative, but requires long-term and dynamic university development processes. Similar to schools, universities are now looking for forms of teaching

and learning that enable students to meet the requirements of the information society. These include in particular problem-solving, self-directed, situated and collaborative forms of study (Laurillard, 2002). Teacher training has a special responsibility here since students should experience a teaching and learning culture that they should implement as teachers in a level-specific modification.

As a result, it became clear that digitalization requirements still need to be systematically anchored in all three phases of teacher training in Germany. Against this background, it is crucial. In this section, the development of perspective teachers that can go hand in hand with improving teacher training in the context of digitalization will be presented.

In order to adapt the already complex teacher training to developments in the long term, a future-oriented overall concept of teacher training in the context of digitalization is needed promptly, which as many (prospective) teachers and schools ensure that competence development in this area is binding (Ackeren et al., 2019). It is vital to involve universities, study seminars and further training institutions, ministries and state institutes, as well as the federal structure of the education system, which includes location-specific features, to be taken into account (Schiefner-Rohs et al., 2018). A central function in the creation from 2019, the KMK standards for teacher training will be used as a basis for an overall concept and the corresponding content design of offers, that will be possible for the first time to systematically revise the teacher training phases in a criteria-oriented manner and to adapt study regulations and curricula accordingly. At the same time, most of teachers who are already working in schools and are not or only slightly involved in digitalization could qualify to professionalize. The development of teacher education and the conception of corresponding offers will represent long-term tasks in the education system in order to continuously deal with the rapid developments of digitalization to be able to take into account. It must be considered that too concretely formulated content and approaches only have a short half-life. The most significant in this process is that teacher education must enable teachers to cope with change and deal with innovations and systematically promote competencies that relate to the design of developments. In addition, there are many media-specific requirements for the implementation of digital media in teacher training and there is already a wide range of international findings (Kirschner et al., 2008, Tondeur et al., 2018). The different measures can be taken along well of the “Model of Teacher Professional Growth” by Clarke and Hollingsworth (2002) as shown in (Figure 1).

Figure 1. Model of Teacher Professional Growth" by Clarke and Hollingsworth (2002)



4.1. The personal sphere, i.e., the knowledge, beliefs and attitudes of the students

Regarding the media-specific aspects of teacher training, the following question can be formulated here: Are the media-related skills and convictions of students activated and revised during the training? Student teachers bring a wide range of previous experience with digital technologies to their training and it is by no means the case that students are a homogeneous group of so-called «digital natives» (Bennett et al., 2008). Addressing the different media experiences in training plays a decisive role not only for the development of skills but also in the formation of media-related orientations and attitudes. These attitudes and the underlying biographical experiences can be made visible in discussions and written reflections and made accessible for change. The goal is a differentiated perspective that also includes media criticism. Networking and exchanging ideas with peers can be essential in this context, which makes it possible to exchange ideas and receive feedback. For this purpose, social media channels could also be used to a greater extent, also in order to socialize students into corresponding discourses during their education.

4.2. The external sphere, i.e., information and stimuli that students receive in their teaching (e.g., by lecturers or practical teachers).

The following question is crucial here: Do the general didactic, pedagogical-psychological and subject didactic modules contain sufficient modules and impulses for digital technologies? The mandatory anchoring of media-related topics in education and training is an essential basis for the acquisition of media-related skills by teachers (Prasse et al., 2017). Media-related topics can certainly be the focus of specialized courses, but they must also be consistently integrated into all other subjects and training courses. As was shown using the TPACK model, subject didactics are likely to be the decisive place where the essential cornerstone for successful media integration in training is laid. As recent overviews in Germany show, in many federal states, there are only a few obligations concerning application skills and media didactic skills of teachers. At the same time, federal states and many individual universities are on the move and are trying to initiate developments in different ways.

4.3. The practical area in which professional action and trying out takes place

The central question here is: Can students experience and try out innovative media practices during their studies? Prospective teachers should get to know digital media as an everyday working and learning tool during their studies.

On the one hand, this includes the didactically sensible use of digital technologies in lectures, seminars and self-directed learning phases (e.g., multimedia learning materials, use of digital tools for personal processing of study content, digital forms of cooperation and communication as well as digital opportunities for proof of performance and assessment). On the other hand, it includes digitally supported forms of learning in practice (competence-oriented seminars, learning laboratories, simulated classrooms, practical schools and internships). In the context of which one's own media-supported learning scenarios or learning resources can be developed, discussed, reflected on and tested in authentic settings. Internship teachers and mentors should offer concrete models, support and formative feedback for the meaningful integration of media in the classroom.

In order to enable students to experience digital teaching practices in practice, some colleges and universities are already working with special laboratory classes or project schools, which are given special support in dealing with digital topics – also through corresponding development and research projects. However, the transfer performance should not be unidirectional, but in the sense of a "community of practice" or a "third space". This should not only be about understanding simple and typical applications in the classroom, but also about developing innovative approaches in own practice.

5. Conclusion

In an overall concept - with a vision for the future development in the field of digitalization in teacher education - it should be clearly stated which goals and which measures for the digitalization of teaching and learning in the verifiable teacher training are to be achieved in defined periods of time and how the development of competence and the integration into practice and with which university didactic and media didactic models as well as subject didactic approaches are created and their effectiveness is checked. With regard to the transferability of the developments, the idea should generally be guiding contents to be made freely accessible as Open Educational Resources (OER) and shared across teacher education sites. In addition to program financing, there is also a need for sustainable support for the new tasks that are permanently in the context of digitalization - not only within the framework of teacher training but also in the area of infrastructure maintenance, technical and (university) didactic advice and personnel development. After all, the focus should not and must not be solely on the first phase of teacher training but also the trainees in the preparatory service, as well as the teachers already working in the school, have to be reached with convincing concepts that have to be developed and promoted systematically.

In Teacher training must provide new technical tools and convey media-related training content in specialized modules. In addition, such content would have to be integrated into general didactics, in its pedagogical-psychological reference disciplines and the subject didactics.

During their studies, students should reflect on their previous media experiences, gather new learning experiences using media and try them out in internships as teaching tools in an innovative way. For this, they need suitable practical models of innovative media practice, relevant coaching and inclusion in a community of practicing and reflecting teachers and students. In addition, the students' competence concerning the effectiveness test of used or self-developed digitally supported teaching-learning designs could be promoted more in teacher training. This also includes dealing with possible side effects, e.g., the increasing automation and datafication of education-related decision-making and selection processes. Ultimately, teacher training is not just about developing media-specific skills, but also about developing media-unspecific skills. In a world where computers are taking over more and more routine tasks, prospective teachers need a degree that enables them to practice complex non-routine skills with students and build up interdisciplinary skills. Even if many universities have already made their way, such postulates are challenging to implement. Despite all the imponderables of digital change, it can be taken as certain that the new technologies and practices will not disappear again any time soon.

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