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ABSTRACT: Digitization is progressing, teacher training - explicitly in the vocational area - is not keeping up. Against the background of current and foreseeable requirements that digitization places on trainees and young professionals, there are a number of challenges for their teachers, which are divided into the main areas of media education, media didactics / methodology and specialist technology. Each of these main areas contains demanding and interdependent aspects, which can be handled proactively both in the course of study and in the course of training.

Editorial: Grundständige digitale Lehrpersonenbildung – nicht in Sicht

ZUSAMMENFASSUNG: Die Digitalisierung schreitet voran, die Lehrpersonenbildung – explizit im berufsbildenden Bereich – hält nicht mit. Vor dem Hintergrund der aktuellen und absehbaren Anforderungen, welche die Digitalisierung an Auszubildende und junge Berufstätige stellt, stehen eine Reihe von Herausforderungen für deren Lehrpersonen an, welche sich in die Hauptbereiche Medienerziehung, Mediendidaktik/-methodik und Fachtechnologie aufgliedern. Jeder dieser Hauptbereiche beinhaltet anspruchsvolle und auch interdependente Teilaspekte, welche sowohl im Studium als auch im Vorbereitungsdienst proaktiv gehandhabt werden können.

When visiting a large-scale industrial production, you do not need an already worn out definition of industry as 4.0. You can immediately see how robots work next to people, how shuttle-based batch size 1 production is carried out at a fast pace in fully automated production lines, how interacting transport systems always provide equipment and tools where they are currently needed, and how they are maintained on the flow machines, because they are independently determined and report in advance when a wearing part might soon cause problems, how service mechanics with data glasses use immersive projections to optimize information phases and comply with safety standards etc. For decades, these systems have been planned and designed by engineers, then assembled, operated, handled and serviced by skilled workers, overseers and technicians. The basis of their professionalism is not a university degree, but an education, their teaching staff are not scientists, but bosses in the company and teachers in the vocational school. With regard to the advancing digital change, the question arises as to where will the trainers or teachers derive their competencies from for them to follow and implement adequately in their educational practice. Neither educators nor lecturers have the same opportunities as university lecturers to update themselves on a scientific level. However, the situation of the trainers is much simpler here than that of the teachers, because on the one hand they can make an ongoing and direct comparison between the technical-productive context of their companies and their training, on the other hand, their teaching requires the use of sophisticated media to a limited extent. In addition, their educational focus is much narrower than that of the teachers at vocational schools, because they require the education of the pupils to reach maturity in addition to specialist teaching, which is an independent and comprehensive task with regard to digital changes. Teachers at vocational schools are currently faced with three challenging development tasks:

1. In their specialist domains, they must find and keep in touch with the technical and productive changes induced by digitization,
2. they must proactively take up the development of teaching-learning media, which is accelerated by digitization, and
3. they have to follow and understand the everyday life and social processes of digitization in order to be able to advise and support their students in this regard.

If one traces the past years, with regard to these three fields of development, teacher training has reacted mainly to phase III. In the federal states there are many offers in all 3 areas, whereby area (2) has been served since the mid-1990s with the arrival of multimedia computers and peripheral devices, areas (1) and (3), however, have only been around for about a decade, triggered by Industry 4.0 and the spread of mobile devices. Teacher training is, however, structured much more simply and can be implemented much more directly and quickly than basic training at universities and in seminars. However, a decade would have been enough time to implement digital changes in the first two phases of teacher training.

If you enter the search term and related items for "teacher training" and "digitization" in the specialist pedagogy department portal, you will get (07.01.2020) 72 results. This initially shows that the topic is current and that activities are taking place. If one looks more closely at the hits, however, one finds that a large number of practical or practice-oriented publications dominate, in which digitization is taken up not so much as a complex overall social process, but rather computer-assisted elements in a teaching setting lead to these keyword hits. Here, too, concepts of further training for teachers dominate, but training is underrepresented. However, individual articles do address the topic in its complexity (e.g. Stratmann, Müller, 2018, Petko, et al. 2018, Seuffert, et al. 2018 etc.). With regard to the first and second phases of teacher training, is the account

by van Ackeren et al. (2019), which illuminates the topic against the background of the "Quality offensive for teacher education", a nationwide program to promote teacher training at universities. Here, among other findings, it was shown that in the first phase of the "quality offensive for teacher education" there were only a few projects in the first two application rounds, "with an explicit focus in the area of digitization or the establishment of media-based learning, in which there are new learning opportunities, new event formats and structural changes with regard to cross-phase cooperation"(108f). From the results of the previous evaluations, the following is summarized: "Media and digitalization have so far hardly been considered systematically as teaching objects, and the comprehensive requirements and necessary changes in teacher training against the background of digital change in view of the high and increasing relevance of the topic, and also against the background of the KMK strategy, have so far fallen too short in Germany. A comprehensive, interdisciplinary and subject-specific, media-related educational science and informatic competence development has so far not been systematic and is therefore not bound to teacher training." The authors see this critical imbalance as further evidence of a nationwide teacher education problem, which was recently disclosed in the "Monitor Teacher Education" (Bertelsmann, 2018). On the basis of a survey in the winter of 2017/2018 at German universities with teacher training as the subject, it was here summarized that teacher training courses "in the 16 federal states is still a long way off from binding content dealing with digital media in all subjects and across all sub-disciplines of courses, as intended by the KMK"(3). Ultimately, this is also confirmed by the (far too optimistic) study by the mmb institute – the Society for Media and Competence Research (Goertz, Baeßler, 2018). Through the analysis of 11 selected case studies, the topic "Digitization in teacher training" was surveyed and, among other things, the anchoring and specialist integration of digital aspects was covered. However, this was reduced solely to the aspect of media literacy, which shows that the overall topic or problem had also only been partially accepted or understood here by these research units. How low the requirements set in this study were is shown by the assessment of the anchoring of media-building courses in subject-specific teaching through interdisciplinary bundling in the practical semester, interdisciplinary projects and targeted cooperation in working groups and institutes as "promising ways" (55) for digitization in teacher training.

The establishment of this state of affairs predictably triggers two very different reactions: Those who have been scientifically or practically engaged in teacher training for a long time shrug their shoulders because it is not developed based on dynamism or agility. Those who are outside the teacher education system but are aware of the importance of this challenge are irritated or alarmed. Therefore, the fundamental misery should here again be deliberately emphasised:

Society, in particular our economy, has been undergoing a comprehensive change for more than a decade, in which new technology has intervened and changed all areas of life in a sustainable manner, and our education system is just realizing that "something should be done here".

I do not want to scare anyone by underlining this, but it must be clear to everyone that what is currently being implemented in schools in Germany with regard to digitization is exclusively the product of individual initiatives or random and anecdotal projects, and not the effect of one systematically organized approach to teacher training. This means that nothing less than the statutory educational mandate is at risk, because how should a school system lead our adolescent generation into a self-reliant life if their central protagonists are neither prepared for reality or the future of this society, let alone able put them in a position to follow their own dynamics and make these accessible for educational processes?

The teacher education monitor shows the extent of deficits currently being revealed here in a very differentiated manner. The article by Ackeren et al. (2019) stated the following in relation to this: “All teacher training institutions must promote the development of digitalization-related skills by integrating and relating them to each other with regard to technical subjects and reflecting that the school is an organization in a social context ” (108):

- Media pedagogical competence (in the sense of knowledge, ability, reflexivity and professional ethical attitude, not only with regard to teaching, but also with regard to school as an organization),
- subject-didactic competence (change / extension of learning objects and subject-specific competences to be promoted under the conditions of digitization and digitality) and
- IT skills (in terms of algorithmic thinking, data literacy, computational thinking and data security)

Although vocational training also refers to the current challenges of digitization for teacher training (e.g. Lang & Wittmann, 2016), no concrete explanations have yet been given as to what this means in detail and how these things should be implemented or by whom. Exceptions to this are individual studies that illuminate partial aspects. For example, Bach (2019) in the domain of construction technology states that "there is still development potential with regard to digital media use in vocational schools and in training companies" (55). It refers to the Bertelsmann study "Monitor Digital Education: Vocational Training in the Digital Age" (Schmidt et al. 2016), in which around 113 commercial and technical teachers and 200 trainers were asked about their digital media use. The causes and reasons for this desideratum are: "Problems with technology in class and a lack of support, lack of availability of technology in class, lack of media (pedagogical) skills in vocational training staff, lack of good practice examples, uncertainty with regard to the added value of digital media usage and the high cost of digital media usage, including high license costs ” (Bach, 2016).

The backlog in teaching-related or teaching-integrative digitization that are thus also present in the vocational training segment are particularly worrying, since there is a particularly large gap between current teaching challenges and the deficient educational approaches for teachers tat exist in vocational schools, which has been opened up by the tremendously accelerated pace of technical and productive change due to digitization. Sloane (2019) sums this up for pedagogical practice in 5 guiding principles:

- "Digitization is reflected in changes in work and business processes and leads to changes in traditional professional boundaries in vocational training, e.g. between commercial-technical and business fields.
- Digitization requires new forms of cooperation between learning locations.
- Digital skills can only be imparted by means of the didactic and organizational skills of the educational staff.
- Digitization requires new teaching and exam formats, but based on an existing forms of pedagogical-didactic professionalism.
- The promotion of digital skills requires a complementarity of pedagogical-didactics and organizational skills on the one hand and technological infrastructure funding on the other.
- Digitization and the promotion of digital competences does not primarily require a revision of training regulations, but rather requires the professionalism of the pedagogical staff when interpreting existing regulatory documents ”. (182)

From this perspective, the continuing education initiatives for the implementation of digital change in vocational education that can be identified in all federal states are like trying to catch chickens instead of building a fence. At the moment it must be assumed that teachers working for several years in vocational schools are better able to cope with the topic than those who come from universities and traineeships. The following explanations should show that this problem cannot be dealt with by adding a few additional seminars (1st phase) or computer modules (2nd phase). Here it becomes clear what topics digitization involves for professional teacher training.

In a first step, the individual topics are outlined, how they are created, what potential is to be attributed to them and what can be expected from their neglect of these teaching deficits. In the second step, these topics are assigned to the two central areas of our teacher training and finally a discussion follows as to how they should face their challenges.

The central reference concept is an ex ante model for digital teaching competences in vocational training, which was generated by comparing the framework models published so far with the requirements of competence-oriented vocational teaching:

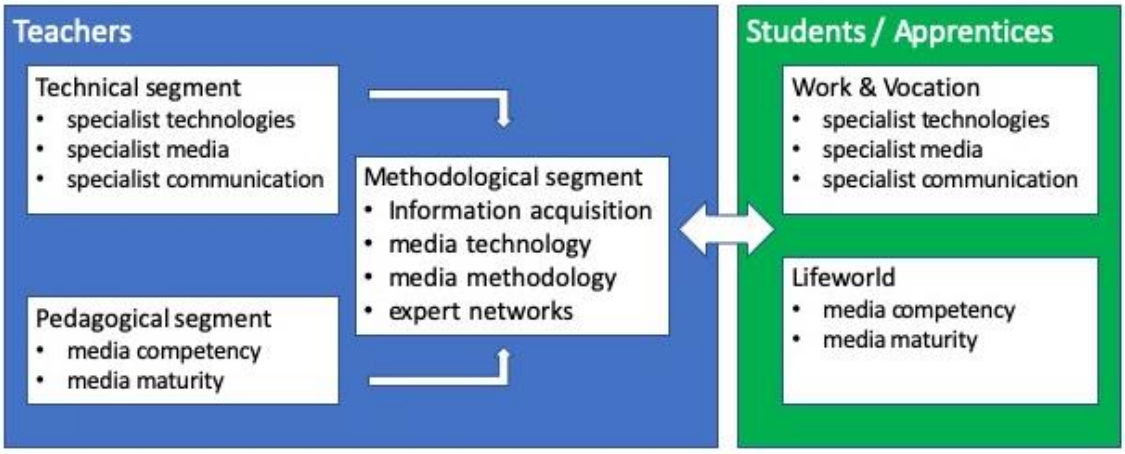

Fig. 1: Model for digital teaching skills in vocational education and training

If you apply the ex ante model (Fig. 1) to teacher training, 9 main areas can be identified, in which the two main phases of study and traineeship can be identified, and in which the digital teaching skills could be addressed:

Tab. 1: Overview of digital focus areas. MPS: Main professional subject, PD: Professional didactics, TS: Teaching subject, DTS: Didactics of the teaching subject, ES: Educational studies. TPMS: teaching practice of the major subject, TPTS: teaching practice of the teaching subject, ICA: interdisciplinary competence area, SL: school law.

	Studium					Vorbereitungsdienst			
	BHF	FD1	UF	FD2	EZW	UP1	UP2	ÜFK	SR
Fachtechnologie	X		X			X	X		
Fachmedien	(X)	X	(X)	X		X	X		
Fachkommunikation	(X)	X	(X)	X		X	X		
Info-Akquise		X		X		X	X		
Medientechnologie		X		X		X	X		
Medienmethodik		X		X		X	X		
Expertennetzwerke		X		X		X	X		
Cybermobbing					X			X	X
Computerspiele					X			X	
Social Media					X			X	
Nudging					X			X	
Cybercrime					X			X	X

As Table 1 shows, there are currently 12 thematic priorities (without claiming to be complete) that appear to be highly relevant for current teacher training. They are divided into three main areas: Area 1 (light blue) is the technical segment in which digital aspects of the main professional subject and the teaching subject are to be found. Area 2 (yellow) is the methodical segment in which digital aspects of learning and teaching are located. Area 3 (orange) is the pedagogical segment, in which digital aspects of education and the protection of learners are found.

1. Technical Segment

The reference area of professional digitization is the most complex development area for teachers in vocational education, with a high and still increasing dynamic. There are also multiple inconsistencies here, which arise from the various industries, professional groups and fields arising in a constantly transforming production and service society, so that not only are the digital segments in the individual technology areas currently continuously in development, but any stable reference point for professional implementation, which has so far been fixed in this regard, will also have come off its hinges. This has so far been less pronounced in some areas and therefore undramatic by simply adding new devices or media (e.g. for carpenters who now work with CNC-milling machines instead of manual ones), in other areas it leads to very strong changes , e.g. in the aircraft service, in which more and more analogue technologies are being exchanged for digital technologies and which are now more than 50% taken up by digital information management. There are three individual topics in the technical segment: (a) the specialist technologies, (b) the specialist media and (c) the specialist communication.

Regarding (a): At best one associates this discourse with specialized technologies, i.e. devices, machines, plants, but also computers and software. This has permeated all professional areas and

groups, e.g. also in human services, in which the monitoring of patients or prosthetics has developed and will continue to do so, or agriculture, in which satellite tracking is used, or agricultural robots are employed.

Regarding (b): What is often overlooked are digital media that have found their way into the professional field. This affects above all those professional spaces that are outside stationary productions, i.e. services of all kinds. Mostly these are digital devices (smartphones, tablets, data glasses) that are used to acquire information, which is also present in presentation media such as beamers. Also in drones that are used by roofers to inspect their work or micro-cameras for examining the smallest of functions and assemblies.

Regarding (c): The digital end devices mentioned in (b) are currently not only used for information acquisition or presentation, but also increasingly for communication, i.e. for the exchange of information between people or expert systems. This refers to the now self-evident use of simultaneous language, mail and messenger applications, but also video-based approaches such as Skype or Facetime. Here, too, there are of course enormous differences in the type, degree of penetration, frequency and importance of using digital technology. What is certain, however, is that it is still gaining relevance and that it is following current developments.

It can thus be summarized that professional instruction in three different technical aspects must be continuously updated. It is not enough to just follow the developments in the field of technology, because with digitization, medialization is increasingly spreading in the professions. If modern vocational teaching wants to live up to the demands of a work or business process orientation, teachers who design and implement it must continually receive all three developments presented here and implement them thematically in terms of content and methodology. That means that teaching learning actions must be embedded in contexts that contain the current technologies and incorporate the current information, presentation and communication processes as learning processes.

2. Methodological Segment

Due to the dominance of general education in the public discourse about the future viability of our education system, specific technical aspects are hardly included, and instead the main focus is teaching methodology. The discussion that has been coming up regularly since the early 1960s about better, faster, more effective, more enjoyable, ... learning through computer support has itself therefore recently intensified again. The ideas of full compensation for teachers, rejected in the past two decades, are emerging again, triggered by the largely naively perceived and interpreted progress in research and development of so-called artificial intelligence. Regardless of such fictions, the past 30 years have been characterized by the increasing use of computers in and around class. So the question is not currently whether teaching should be digitized, but rather how and with what. The current digital pact, which intends to upgrade the hardware and software of schools in Germany, shows how awkward our educational system itself is in relation to this simple question. Again, general education is the main focus, but the formula also applies to vocational education and training that can only be learned digitally where appropriate hardware and software are available. However, what was forgotten in the digital pact is the central question of whether and to what extent teachers are able to implement these and future digital elements in a methodologically adequate manner. The fact that this problem cannot be solved with one or two media courses is shown by its division into four independent aspects of digital didactic-methodical skills for

teachers: (a) information acquisition, (b) media technology, (c) media methodology and (d) expert networks.

Regarding (a): From the teaching methodological point of view, information acquisition has two independent facets: In the first case, it is an immediate teaching competence, i.e. the ability of a teacher to provide information for their own lessons or for projects and exams in a targeted, precise manner and also up-to-date and to acquire them correctly. In the second case, it is a learning competence that has to be conveyed to the learner. What is certain is that in both cases digital technologies and their semiotics have become dominant. Anyone who wants to get current and relevant information today must know and operate the appropriate digital systems. The world has become accessible much better, faster, more comprehensively and is more up-to-date thanks to digital technologies, so that behind the aspect of information acquisition in addition to the methodological possibilities lies a not insignificant educational aspect. Teachers therefore need (direct) digital information literacy and (indirect) mediation literacy to achieve information competence. These are predictably directly related, in that teaching skills for teaching staff require correspondingly mature digital information skills.

Regarding (b): Digital teaching media are now very widespread. Some come and go (such as the smartboard), some displace analogue media (such as the beamer or overhead projector) and some simply come in (such as the document camera). The use of teaching media has always depended on how simple and reliable they are and the effort that has to be made to deal with them appropriately. This clearly shows in that the smartboards remaining in our classrooms are mostly used as projectors. You can call it pragmatism or ignorance, or you can just find that the likelihood that innovative digital media will be used for teaching increases with the expertise of the teachers in using these media. With the now good and easily accessible technologies of Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) there are hardly any methodological possibilities left for teaching-learning processes *ante portas*. However, in order to bring them into the classroom, the teachers need media technology skills, i.e. competencies that enable you to understand, apply, acquire, modify and implement programs such as AR, VR or MR hardware and software. Besides and inevitably following on from these virtual or immersive technologies, others will come. Whether they arrive in the classroom is first determined by their availability, but then also how they are used by teachers.

Regarding (c): media methodology is a genuine field of didactics. With the proliferation of computers at the end of the 1980s, a computer-related media methodology was established across domains. Its main concern is the targeted methodical use of digital technologies for teaching and learning processes in order to make them more motivating, effective or efficient. Digital media methodology has not only significantly exceeded the relatively limited possibilities of analogue teaching and learning media, but also direct teaching in terms of space and time. This started with the spread of the Internet in the late 1990s. A further decade was added with smartphones and tablets, and messenger applications, web groups and wikis were also implemented methodically. The need for digital media methodological competencies is thus evident, but the overall scope is already broader than is generally assumed and it is growing.

Regarding (d): The presumably least considered aspect of digital methodological skills is that of expert networks. It could also be assigned to the aspect (a) of information acquisition, but this would clearly overload it, because this is not about unidirectional collection and processing of information, but rather the multi-directional exchange of information in a didactically and methodologically profiled context. Therefore, this aspect would also fit the subject segment (1), because when teachers exchange ideas about their teaching, both subject and methodological components are usually discussed or are inextricably linked. Simple examples are exchange platforms for

teaching concepts, which get more complex in subject-specific groups, which are mostly formed on an informal basis in order to practice collegial teamwork across spatial and temporal boundaries. There they do not work in a co-acting, but collaborative way, that is, lessons are developed under common premises, which are then available to everyone and are also developed, supplemented, etc. It remains to be seen whether independent skills are required to participate in such networks, or whether this is an aggregate of virtual communication skills and collegial social skills. What is certain is that it is a digital competence aspect that has become particularly relevant from a methodological point of view and will become more relevant in the course of digitization.

In summary, the methodological segment presents itself as more complex than would initially be expected. Based on the media methodology, which is of course located here, this can only be adequately handled in digital arrangements if there are also media technology skills. Information literacy proves to be a multi-dimensional requirement, because it is both a teacher and a learner competence and thus implies a reciprocal set of conditions. Finally, there is also a collaborative aspect, because the digital media enable new forms of cooperation between teachers, which require specific social and communicative skills.

3. Pedagogical Segment

With the pedagogical segment, we leave the area of teaching that is geared towards imparting specialist competencies and turn to imparting interdisciplinary competences. One can also say that this is education‘s realm, i.e. to support developments in learners that are geared towards their personal development. No matter how one describes this aspect of teaching, it is clear that it can hardly be separated from it. Education does not take place in independent teaching, but is an ongoing part of it. With digitization, the support for personal development at school not only resulted in new, but also extremely significant and serious challenges. All in all, the aim is to make young people fit to orientate themselves in an increasingly digital world and to protect them. The orientation aspect is comprehensively addressed through school lessons - if it meets the preceding requirements in technical and methodological terms - especially if information, communication and design skills are specifically promoted among the learners. The protection aspect is currently predictably neglected, because it would not only require independent subjects or subject areas, but also very specific teaching skills: At the center of these teaching skills is expertise on (a) cyberbullying, (b) computer games , (c) social media, (d) nodging and (e) cybercrime.

Regarding (a): Cyberbullying has meanwhile become a common phenomenon in schools worldwide. Group applications such as Facebook, Instagram, Snapchat or Whatsapp in particular offer ideal conditions for this, because they enable immediate, quick and reliable distribution of texts, images and videos among peers. There has always been teasing at schools, but when this takes place in digital form, it reaches a completely different intensity and therefore threatens children and young people. Suicides have increased significantly as a response to cyberbullying, and even if it doesn't go that far, it causes tremendous social-emotional damage to those affected. Cyberbullying can only be handled by teachers who have been trained in this area. This includes competencies that relate to the media and applications used, but also socio-pedagogical skills concerning the way in which intervention can be effective and sustainable.

To (b): Computer games are very common and have become an integral part of our learners' leisure landscape. There is a lot of discussion about their use or harm, it is clear that their excessive use has addictive potential, and there are also computer games with racist or violence-glorifying content that can favor negative developments in young people. Computer games only become a

school topic when learners show deficit behaviors that are triggered or intensified by them. In order to recognize such behavior and to be able to understand the cause, an adequate diagnostic competence is required in order to be able to react to this, an overview of external help and possibly appropriate cooperation is required above all - a simple discussion with parents will hardly help here.

Regarding (c): Social media - similar to computer games - has become a very widespread and initially non-development-damaging digital technology. But here too, the question of the effects depends crucially on the type and intensity of use. Deficient use of social media poses enormous dangers for personal development, since social spaces can be opened up and engaged with that only exist virtually and thereby compensate for specific social contexts. These young people lose touch with the reality of peers and can largely avoid their challenges, with the result that essential social skills are not developed or are developed only rudimentarily. In addition, fake worlds can also be built up via social media by generating an idealized personality image that is more or less distant from individual reality. On the one hand, this creates an inauthentic social structure, in which you only perceive yourself as a synthetic construct among many others, on the other hand, it prevents a realistic examination of your own and other's strengths and weaknesses and their comparison, i.e. an important development task for young people.

Regarding (d): The term "nudging" comes from behavioral economics and is understood to mean the targeted transmission of information to people in order to influence their behavior. This is done openly, e.g. by signs on the highway, which represent accidents to encourage careful driving, it appears socially acceptable, if the intentions are hidden, it is a matter of manipulation. In the course of digitization, completely new possibilities for nudging have opened up, on the one hand through the diverse media spaces that have arisen as a result, and on the other hand through the responsive technologies available (or made available) for this purpose. A typical example of this are filter bubbles, i.e. information spaces that are tailored to the maximum of an individual's specifications to conform to their settings and thus increase the attractiveness of that information space. The system recognizes what people particularly like to read or see and provides exactly those texts and pictures. Internet advertising with the underlying analytics and data warehouse systems now works worldwide using this logic. It becomes critical when political parties make use of these mechanisms. Therefore, digital nudging can be viewed as a threat to democracy. In order to make nudging accessible and understandable for learners, teachers must have the appropriate expert knowledge and also be able to follow its various types and developments.

To (e): The area of cybercrime is far and wide. It has an enormous risk potential for our children and adolescents, because in many cases these are the immediate targets or victims. This applies first to attacks on digital devices by malware, or also to identity theft by phishing and similar practices, which are used to penetrate password-protected areas. However, it applies in particular to contact by pedophiles via the Internet, child pornography and access to the criminal area of the Internet, the so-called Darknet, in which, among other things, the black market, drug trafficking and racist groups have gained a foothold. In order to be able to have an educational influence here as a teacher, it is again necessary to be at least informed about these problem areas, to know how to recognize and combat them, or how to react when things have happened in this regard.

It can thus be summarized that in the "pedagogical segment" discussed here, compared to the first two segments, there are a number of other, highly relevant challenges for teachers, which mainly relate to the protection of young people or the establishment and expansion of their self-protection in an increasingly digital world. In order to do this, a lot of specific knowledge is required, which also has to be updated again and again, along with a range of diagnostic and socio-

educational skills. Especially with regard to the dangers of cybercrime, the enormous and increasing tension becomes clear regarding the possible dangers for young people on the one hand and how small the opportunities are for teachers to have a helpful influence here. Nevertheless, you have to face it because nobody else does, and because parents are usually overwhelmed on this issue. In addition, it is still a state educational mandate to make our young mature enough to be a responsible part of society. This also includes preparing them for current and future dangers.

Interim conclusion

In three separate areas it was shown which competencies are required for teachers - especially in vocational training - with regard to the current and future challenges of digitization. The current level of competence could be empirically ascertained, but it is certain that this is only to a small extent due to our teacher training, because there has so far been no recognizable reaction that could take into account the extent, differentiation and consequence of the overall problem. Such a reaction also seems difficult to imagine or implement in view of the state and location-specific diversification of our teacher training in Germany, in addition there is the two-phase approach, which has only a limited curricular alignment and is characterized by very different goals, approaches and framework conditions. The most comprehensive approach to improving teacher training in Germany over the past few years shows how difficult integration is here, as the teacher training university offensive was and is limited to the first phase. So if teachers in Germany currently have digital skills, it is not foreseeable that our teacher training will be a success, but rather an achievement of the individual. It goes without saying that the limits of motivation and resources are reached relatively quickly. The following explains how specific areas of universities and preparatory staff could face this challenge. The university-level teacher training - based on the professional teaching position - is segmented into: S1. Professional major, S2. Didactics of the major subject, S3. Teaching subject, S4. Subject didactics of the subject, S5. Education studies, V1. Teaching Practice of the Professional Major, V2. Teaching practice of the subject, V3. Interdisciplinary competence area and V4. School law. First, the five development areas in university teacher education are presented:

S1. Professional major: The study of the professional major is mainly implemented in the relevant subject areas of the universities, e.g. Metal technology in the field of mechanical engineering or business education in the field of economics, etc. They are therefore responsible for offering courses in which the latest digital specialist technologies are made accessible. This would predictably be met with a great deal of understanding, moreover it is also easy to implement or has already been implemented, since the teaching students are predominantly assigned to undergraduate courses (for engineers or business economists etc.) and these are and will be updated digitally in the foreseeable future. This cannot integrate the two equally relevant aspects of the specialist media and specialist communication, because these are rarely a subject of university teaching, but are instead elements of a professional reality that the university only perceives to a limited extent. This could only be compensated for by appropriate internships, but here there are only limited control options for the university, so that the aspects of specialist media and specialist communication ultimately have to be taken up by professional didactics and taken over responsibly.

S2. Subject Didactics of the major subject: The topic of subject didactics is often attached to the relevant subject areas of university teacher training. As Table 1 shows, this has to play a central role in the course of a systematic implementation of digitization in teacher education in the university segment. They are not only responsible for the entire methodological segment, they also

have to share the aspects of the specialist media and specialist communication that are difficult or impossible to achieve by the specialist sciences. In view of the fact that most of them are lecturers or seconded teachers from the school service, who work part-time without support personnel and equipment, this requirement turns out to be excessive. Conversely, it can be stated that only where professional didactics can be taken seriously and handled in professorial structures, will an adequate response to the challenges of digitization for vocational teacher training be expected or achieved. Even then, the task is quite demanding and can only be mastered in the future if the respective teaching unit is consistently geared towards a digital future, i.e. if the many technical media, specialist communicative and methodical facets are consistently implemented and continuously updated.

S3. and S4. Teaching subject and subject didactics of the teaching subject: For both of these areas, similar conclusions apply as for the two previous ones, whereby the three aspects of the subject segment have (at least so far) relatively little requirements compared to the main subject. This allows the four subject areas to be focused on in the subject area. In contrast to the professional area, it can be assumed that there are already extensive networks of experts, which in turn can have a positive effect on the other three aspects. In addition, the general subject didactics at universities are significantly better equipped than professional ones. Thus, it can be assumed here that implementing digital change in teacher training has a good chance.

S5. Education studies: Our teacher training courses are mostly roughly divided into three areas: the two subject areas and a third interdisciplinary area. This essentially covers educational science topics and content. In order to take account of the above-mentioned aspects of personal development, a scientifically backed media pedagogy is required, which consistently takes up topics such as computer games, social media and nudging and works with students. Courses with a socio-educational and socio-psychological background would also be required for the topic of cyberbullying. Expertise is required for the subject areas of cyber crime, which is only rarely and randomly available at universities. Therefore, it seems necessary to provide corresponding teaching assignments.

In summary, it can be stated here that a number of challenges could be overcome with little or moderate effort in the university area. However, it is assumed that a scientifically backed media pedagogy is available and that resources are also available through which relevant teaching assignments can be realized. However, professional didactics itself presents a major problem, as it not only has to implement its specific topics, but also take over aspects that cannot be handled by the university's specialist sciences. This appears in the current structures, which - in terms of equipment and personnel - can hardly meet the conventional requirements now or from the past few years. Therefore, significant improvements would be required here, so instead of teaching assignments or secondments, professorial structures with corresponding research and development opportunities would be needed, as well as securing personnel resources, so as to make it possible to attract very good candidates with scientific and practical qualifications who can transfer this directly to teaching.

In the second phase of teacher training, four further development areas can be discussed: At the center of the traineeship is planning, conception, implementation and reflection on challenging lessons. To ensure this, an independent practical didactic format is generally offered for the main professional subject and for the teaching subject, which specially qualified subject managers or seminar teachers implement directly in school. Superordinate topics or special areas are the responsibility of the study seminar directors and are now organized as modules in most federal states. In view of the official status of teachers and the specific legal challenges of the teaching profession, one of these modules focuses on school law as standard.

V1. The same teaching practices apply for the main vocational subjects as the science disciplines and also for the didactics of the main vocational subjects: They should generally include all digitization aspects of the specialist and methodological segments. This seems difficult given the contextual limitations that result from its direct anchoring in school practice, especially with regard to the methodological area, which has always been leading the way in everyday teaching practice, which is particularly true in the case of digitization. In view of the premise of an action- or business-process-oriented lesson, however, topicality is indicated here in any case. That means that subject managers should be able to teach preparatory teachers how they can identify current specialist technologies and specialist media and find out how digital communication is carried out in their respective domains, so that this can be incorporated into the design of their own teaching experiments. In terms of the media aspect, it is less about using the most up-to-date media in class and more about introducing media-dynamic professional practices. Concerning media technology and media methodology it is therefore less a case of immediate instruction and more a discussion based on exemplification. In contrast, digital information acquisition is of central importance: this should be internalized by teachers in the traineeship to such an extent that they can not only practice it professionally, but also integrate it into their learning environments. The traineeship is much more suitable for an entry into expert networks than studying, because concrete lesson planning takes place there relatively rarely. If this is implemented consistently, traineeship teachers can make an enormous contribution nationwide and continuously enrich the expert networks.

V2. The aspects of the professional subject discussed above apply to the teaching practice of the subject, whereby the technical aspect must be significantly reduced, when no technical-productive change takes place. Nevertheless, digital technologies are also finding their way into the natural and social sciences, although there are major subject-specific differences. Specialist managers should keep an eye on the relevant developments and make them available to their teachers in the traineeship.

V3. In the interdisciplinary area of competence in the study seminars, personal and social skills of the students are generally addressed. All previously outlined aspects of problems and dangers that go hand in hand with the spread of digital technologies fit into this area. The study seminars should examine and supplement their portfolios in this regard in order to prepare teachers in the traineeship for these challenges in a practical manner.

V4. A special topic in the traineeship is school law. Here, too, central issues arise, particularly with the topics of cyberbullying and especially cybercrime, which can only be dealt with in everyday school life if teachers have been adequately prepared for them.

In summary, it can be stated here that a number of challenges can also be mastered with little or moderate effort in the traineeship. This concerns aspects V2, V3 and V4, because the main focus is on supplements to the existing concepts or the exchange of less relevant topics for more relevant ones. The V1 area is problematic, because here it is important not only to keep track of the technical and productive changes in a large domain, but also to work through the lessons so that they can be taken up constructively by the teachers in their traineeship. It is inevitable that this can only be done as an example, i.e. in one or two main occupations of a respective domain. In any case, the subject leaders or seminar teachers must be specially qualified for this. In order to be able to follow digitization in the media segment, foreseeable collegial structures are required, which are applied across the domains in the teacher training colleges. This reduces the effort and facilitates the increasingly complex discussions between media technology and media method requirements.

Discussion

At the outset, it was deduced that there is currently a significant personnel problem in our dual vocational training system, because teacher training in the professional sector has so far barely responded systematically to the challenges of digitization. In particular, three significant segments can be distinguished here: the professional area as a transformation field of digitally accelerated technical-productive change, the media-specific area as a professional field in which teaching and learning skills currently merge into one another through computerization, and finally the pedagogical area as a space for social integration, which is a significant and risky area of intervention by digitization. These segments are relevant both for the 1st phase and for the 2nd phase of teacher training. In the university sector, the central challenge lies above all in the specialist sciences and subject didactics; in relation to the study seminars, the specialist managers and seminar teachers are particularly challenged. As already indicated, this implies not only curricular, but especially qualification-related consequences in both organizational units. That means that courses are either updated digitally or that new courses have to be implemented and replaced with old ones. In addition, subject managers and seminar teachers in the study seminars as well as subject didactics at the universities must be adequately qualified for both the technical and the media areas.

Whether or to what extent such a departure is possible depends on the responsible positions adopted in the two teacher training areas, i.e. ultimately on the cultural spheres of the federal states. I posed the question (Tenberg, 2018, 340) whether these are willing or able to react adequately here: “The digitalization that currently affects our entire industry and also the trades of production, services, work organization and qualifications have changed - in the 'timeless' structures of teacher training described above - if at all - then at best they have arrived as 'information from the outside world'. How should it have been implemented there? The accreditation periods for degree programs are long-term and require an enormous amount of negotiation and committee work, in which it is not the innovation, but the minimum consensus achieved that wins. Once a course content has been accredited, it has been cemented for many years and must be taught - regardless of innovations that arise during this period. The study seminars lack both the innovation and the quality assurance mechanisms to be dynamically receptive to digitization (as already described).” So we can only hope that a further wave of the quality offensive for teacher training will be released, which will at least trigger a reaction from the universities. The study seminars, however, remain “hidden in plain sight”, because their development mechanisms are difficult to see and understand from the outside. However, the digital pact comes too early with regard to this account of it, because the funds to be distributed with it should be used for innovative teaching, not for the financing of equipment that is either not at all or only marginally implemented in a didactically-methodical manner, or is itself quickly moved away from being a digital showpiece into the hands of a media store keeper who then disappears with it into a storage room. So it is currently (once again) up to each individual teacher how they are positioned for digital change. I question whether this meets our requirements and, above all, those of the dual partner, with regard to the ongoing process of digitalization.

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