Media-related Educational Competencies of German and US Preservice Teachers. A Comparative Analysis of Competency Models, Measurements and Practices of Advancement

Part I: Modeling Media-related Educational Competencies

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The following part is concerned with modeling media-related educational competencies from a theoretical viewpoint. First, the state of research in both countries will be summarized in the following chapter by a selection of central, related models and frameworks from an international context and from the USA and Germany. Generally, all competency models share a certain dependence on their national or international background or origin. This is true for deductively derived models, which mirror a certain selection of sources considered important by the researchers, and it is equally true for inductively developed models, reflecting practices and experiences from a specific background. Hence, the structure of presentation follows the objective of including a wide range of respective backgrounds. Although the main focus of this dissertation is on a comparison of Germany and the USA, it is yet valuable to include international models in the following considerations as well. Characterized by an explicitly broad applicability and impact, they offer a contrast and enrichen the perspective with potentially different foci and emphases. Hence, the perspective will be widened to international models first and then narrowed down to the USA and Germany, as the two countries of key interest.

In favor of a systematic presentation of selected central models, a category-based exploration will be introduced in Chapter 4. With regards to appropriate categories for such a presentation, a glance at existing models reveals that there are numerous model characteristics that are helpful to contrast for a systemic exploration. It will be subject to Chapter 5 to bring together and systemize these characteristics and to apply the resulting categories to examples of models in detail. To facilitate such a grounded analysis, the main objective of Chapter 4 will be to provide an overview of existing models and thus depict the international and national backgrounds of the two countries focused in this dissertation. At the same time, this presentation will serve as a suitable basis to select appropriate models for an in-depth analysis. Against the background of these objectives, it appears functional to focus on selected model characteristics to achieve a comprehensive and context-focused presentation of central contents.

From the spectrum of cases introduced, three models will be identified for a successive in-depth comparative analysis in Chapter 5, where a systematic approach will be developed and applied to describe, analyze and compare these models. The overall aim of these analyses is to provide an answer to the first of the research questions: "Which central models of media-related educational competencies are there in German and US research, and what are their shared characteristics and differences?"

4. Overview of Models of Media-related Competencies

To identify suitable models, an electronic search was initially conducted, combining both Google Scholar and the electronic search engine of the University library which searches, e.g., the databases Education Resources Information Center (ERIC) and FIS Bildung Literaturdatenbank. Literature previously known to the author was also considered and relevant sources were added to the data basis. The following three limitations were predefined for an inclusion of sources: 1) Publication date: published after 2005, 2) National background: either from the USA, from Germany or from an international background, 3) Availability: with full-text availability. To account for the varying terminology in the field, different sets of terms both in English and German were searched and combined. The first set included, e.g., "digital," "media," "technology," or "ICT." The second set of terms consisted of terms like "competency," "competence," "knowledge," "skills," and "literacy." The third set of terms included "framework," "model," "guidelines," and "standards." The fourth set comprised terms like "educational," "pedagogical," "teacher education," "teacher preparation," or "teacher." The selection of models from the results of this research for inclusion into the following overview primarily followed the criterion of relevance: models included are received and used widely and contribute to the pedagogical discourse on media-related competencies in their countries or respective backgrounds. In accordance with this interdependency of the different models, the presentation will follow a chronological order to visualize the development within the research traditions in the given frame, starting with the broader background of international models and then narrowing down the perspective to models from the US and Germany as the contexts of key interest for this work. To achieve a systematic comparative perspective and to focus the viewpoint in favor of a structured overview, the following competency model characteristics were selected for inclusion in the following presentation: 1) author and background, 2) structure and main contents summarized, 3) model function, and 4) impact and connection to the research background.

4.1 International Models

A selection of suitable examples from the field of international models includes the European eTQF – Teachers Competency and Qualifications Framework in the use of ICT's in education (FIT Ltd. et al. 2010), the UNESCO ICT Competency Framework for Teachers (United Nations Educational, Scientific and Cultural Organization [UNESCO] 2018), and the DigCompEdu Framework (Redecker 2017).

4.1.1 eTQF

The eTQF Teachers Competency and Qualifications Framework in the use of ICTs in education (FIT Ltd. et al. 2010) stems from a mixed background with authors coming from the industry sector (FIT Ltd.), governmental authorities (The City of Dublin Vocational Education Committee), and research (FOR.COM Consortium and South West College). Its development has been funded with support from the European Commission.

Teachers' ICT competencies are structured into four competence areas, namely 1) ICT, 2) Pedagogy, 3) Curriculum and Assessment, and 4) Professional Development. Each of these competence areas comprises one to six aspects, for example, "Administration" in the field ICT or "Teaching and Learning" in the field Pedagogy. There is a four-step proficiency scale to differentiate the level of competency for each of these aspects. For example, the aspect "Administration" from the field of ICT ranges from the introductory level of "Aware of the use and benefits of student management systems," up to the expert level of "Source, critique and implement emerging learning management systems as appropriate to the educational context" (FIT Ltd. et al. 2010).

The main function of the eTQF framework is described as supporting teachers' acquisition of ICTs. It is amended by an online tool to identify one's own strengths and fields for improvement and is supposed to help teachers, headmasters, education managers and education authorities to support competency acquisition (FIT Ltd., n.d.). In accordance with this, there is an explicit focus on inservice teachers and continuing professional development.

The link between the eTQF framework and the international research background is challenging to reconstruct due to the missing disclosure of sources. However, the fact that partners from Ireland and Italy collaborated and that there was EU funding renders an inclusion of sources from different national backgrounds likely. Moreover, a press release announced the involvement of over 200 teachers in Ireland, the UK and Italy (FIT Ltd., n.d.). This points to an impact of the framework on teachers in at least three European countries and thus suggests a contribution to the context of European teachers' continuing professional development. In terms of scientific reception, this model overall appears seldom referred to in related research, except for mentions in overviews of related models (e.g., Zervas, Chatzistavrianos, and Sampson 2014; Sergis, Zervas, and Sampson 2014). However, eTQF apparently achieved a certain impact in its function as a basis for the development of further models, e.g., the Norwegian Professional Digital Competence Framework for Teachers (Kelentrić, Helland, and Arstorp 2017), or for DigCompEdu (Joint Research Centre [JRC] 2017).

4.1.2   UNESCO ICT CFT

The ICT CFT Competency Framework for Teachers has been published by UNESCO and recently updated to an improved version 3 (2018). Support was provided by stakeholders from the industry sector (CISCO, Intel and Microsoft), by educational researchers (ISTE), and by further experts, e.g., European Schoolnet and Joint Research Centre (United Nations Educational, Scientific and Cultural Organization [UNESCO] 2018).

The framework is designed as a matrix. On the left axis, there are six competency areas, which are, 1) Understanding ICT in education, 2) Curriculum and Assessment, 3) Pedagogy, 4) Application of Digital Skills, 5) Organization and Administration, and 6) Teacher Professional Learning. In the sense of a proficiency scale, there are three successive stages of teacher development at the upper axis: 1) Knowledge Acquisition, 2) Knowledge deepening, and 3) Knowledge Creation. The fields resulting from both axes are filled with competency aspects desirable for teachers. To give an example, the three competency aspects included in "Teacher Professional Learning" are "Digital Literacy" on the stage of Knowledge Acquisition, "Networking" on the stage of Knowledge Deepening, and "Teacher as Innovator" on the stage of Knowledge Creation (United Nations Educational, Scientific and Cultural Organization [UNESCO] 2018).

The main function of the framework is guidance for pre- and inservice teacher training on the use of ICTs across the educational system, with teacher educators, educational experts, political stakeholders, teacher support personnel and other professional development providers as a target group (*ibid.*).

According to UNESCO (2018), the previous 2011 version of the ICT CFT was quite influential on a global level, an assumption which is supported by references in multiple further sources such as overviews of respective models and reviews (Zervas, Chatzistavrianos, and Sampson 2014), implementations on school level (Sergis, Zervas, and Sampson 2014) and on the level of national curricula (Butcher, Moore, and Hoosen 2014), implementation guidelines (Midoro 2013), or studies and surveys (Ansong-Gyimah 2017). It is described to have impacted national educational policies, the creation of national teacher standards, national levels of teacher ICT competency and training initiatives, education curricula and professional development courses (United Nations Educational, Scientific and Cultural Organization [UNESCO] 2018). Hence, there is a strong link between this global framework and a presumably high number of national educational contexts.

4.1.3 DigCompEdu

A third international model is presented by the DigCompEdu framework (Redecker 2017). It was published by the Joint Research Centre of the European Commission [JRC], which is a service of the European Commission (cf. Chapter 5).

DigCompEdu proposes six competence areas that comprise 22 educator-specific digital competences. The first area, professional engagement, aims at professional engagement. This includes Organizational Communication, Professional Collaboration, Reflective Practice, and Digital CPD. Area two includes competences relating to digital resources: Selecting, Creating and Modifying, and Managing, Protecting, Sharing. Area three is about teaching and learning, i.e., Teaching, Guidance, Collaborative Learning, and Self-Regulated Learning. The fourth area refers to assessment tasks in the context of digital resources, namely Assessment Strategies, Analyzing Evidence, and Feedback & Planning. Area five describes competences needed for the empowerment of learners: Accessibility & Inclusion, Differentiation & Personalization, and Actively Engaging Learners. Finally, area six focusses on the facilitation of learners' digital competence, which includes Information & Media Literacy, Communication, Content Creation, Responsible Use, and Problem Solving (Redecker 2017; cf. Chapter 5.2.4).

Each of these aspects is further specified by increasing levels of progression. These competence stages are linked to the six proficiency levels by the Common European Framework of Reference for Languages (CEFR), ranging from A1 to C2, and coupled with the following role descriptors: Newcomer, Explorer, Enthusiast, Professional, Expert, Pioneer (Redecker 2017, 28). Corresponding proficiency statements reflect these levels of progression, as for example in 3.1, Teaching, in the field of Teaching and Learning: the progression for the level of A1, Newcomer, is described as "Making little use of digital technologies for instruction," and the corresponding proficiency statement is "I do not or only very rarely use digital devices or digital content in my teaching" (Redecker 2017, 53). Proficiency increases up to the highest level of C2, Pioneer, which describes an educator "using digital technologies to innovate teaching strategies": "I provide full courses of learning modules in a digital learning environment. I experiment with and develop new formats and pedagogical methods for instruction" (*ibid*).

The main functions of DigCompEdu are summarized as a conclusion on, and summary of, existing literature, guiding policy across all levels; a template for the local development of concrete instruments, discussion and exchange of best practice across borders; and a reference for the validation of local frameworks and tools (Joint Research Centre [JRC] 2017).

An earlier draft version of the framework discloses its sources, and it becomes evident that a broad basis of national and international, mainly European, media-related competency frameworks, guidelines, standards, etc. was used for the

development of DigCompEdu, and that great efforts were taken to ensure an appropriate evaluation and inclusion of the competencies found in these sources (*ibid*.). To this degree, it builds on a broad background of sources and serves as a summary of a wide research background. The impact of DigCompEdu is increasing quickly, especially in terms of application scenarios (Kullaslahti, Ruhalathi, and Brauer 2019; T. Koehler, Igel, and Wollersheim 2018; Benali, Kaddouri, and Azzimani 2018; Blanchard et al. 2019; Caena and Redecker 2019; cf. Chapter 5).

4.1.4 Interim conclusion on international models of media-related educational competencies

The three competency models introduced in this chapter all share a distinct international focus and strive for international applicability. Yet there are differences inherent in the three models, for example, with regards to authorship, structure and content focus, function, and impact and connection to research background. These model characteristics will be juxtaposed in the following to achieve a first contextual comparative viewpoint.

Both eTQF and UNESCO ICT CFT stem from a mixed background, as research institutions, industry partners, political and further stakeholders contributed to the model development process. Hence, a range of different interests can be assumed to have influenced the model's drafting, potentially including motivators like reputation or financial interests among the prevailing research-based objectives. DigCompEdu, on the other hand, was developed by a research team from the Joint Research Centre as a service to the European Union. The research background suggests a strong political perspective in the model and a corresponding focus on European international applicability and feasibility.

The model structures vary, as can be seen on first sight. ETQF and UNESCO ICT CFT are both designed as a matrix, which facilitates a conform structure but appears less flexible compared to DigCompEdu. DigCompEdu, on the other hand, has a considerably high complexity, with highly detailed competency descriptions and proficiency scales. It will be necessary to research in greater detail in the following in-depth analysis the effects that different levels of complexity and detail can have on the applicability and usefulness of models.

With regards to contents, it is obvious that eTQF has a clear emphasis on ICT. There are six competency aspects in relation to ICT, while there are only three in the field of pedagogy, which illustrates this emphasis. The date of publication is relevant in this regard: eTQF was published in 2010, and the understanding and emphases of the relation between ICT and media-related competencies evolved significantly since then. This can also be spotted in the adaptations made to the UNESCO ICT CFT from 2011 to 2018: the former competency field "ICT" was reorganized as "Application of

Digital Skills" and thus illustrates an advanced and contemporary understanding of ICT subordinate to respective pedagogical skills or competencies. UNESCO ICT CFT focuses more on the educator perspective and competencies and less on the technologies. This approach is even enhanced with DigCompEdu which leaves behind the matrix format and postulates innovative and flexible competency fields around media-related competencies that are usually closely connected to teaching and learning contexts (cf. Chapter 5.2.5).

In terms of functions, all three models summarized above share the general objective of contributing to initial and continuing teacher education through guidance and orientation and of enhancing research and practice with a systematic model. In accordance with the political relevance pointed out in the context of authorship, DigCompEdu additionally emphasizes international applicability and guiding policy as important functions.

More differences between the three models become obvious in the context of impact and connection to the research background. While eTQF was received primarily as a source for the development of further models, UNESCO ICT CFT achieved a high impact, and research around DigCompEdu is also evolving increasingly. It will be subject to in-depth analysis in Chapter 5 to explore which differences between models have an impact on their varying relevance and reception. The following sections will illustrate how far respective model differences and shared characteristics also apply in the national contexts of the US and Germany.

4.2   US Models

In the USA researchers have also been working on defining and modeling the respective competencies. The US research context comprises research-based models (TETCs), knowledge models (TPACK), and guidelines or standards with a distinctly practical focus (ISTE standards and NAMLE Core Principles of Media Literacy Education). Notably, such guidelines are often not equivalent to scientific competency models in terms of research foundation and validation. According to Tulodziecki and Grafe (2019), competence needs to be concretized by standards for different age groups or target groups in order to be used as an objective or reference point for educational processes. Hence, standards should be based on models and can be understood as a bridge or linking element between models and practice. However, the ISTE standards and the NAMLE Core Principles of Media Literacy Education have a comparably large impact on the US context of initial teacher education and reveal that the distinction between models and standards is not always realized systematically. Therefore, it is considered pragmatic and suitable to include both standards and models in the following, despite their systematic dissimilarity.

4.2.1 TPACK

TPACK is a well-established model that describes the concept and interplay of Technological Pedagogical Content Knowledge. It was published in 2006 by Mishra and Koehler based on their experiences as teacher educators in a US initial teacher education program and on Shulman's (1986) concept of Pedagogical Content Knowledge.

The TPACK model basically postulates three knowledge domains central to teacher professional knowledge: Technological Knowledge (TK), Content Knowledge (CK), and Pedagogical Knowledge (PK). The three domains are not separated but overlap: this way, the domains of Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK) emerge. At the point where all three domains overlap, Technological Pedagogical Content Knowledge (TPACK) emerges as an interplay and combination of all elements. These dimensions of knowledge are not further specified in the model but are explained in detail in related publications (Mishra and Koehler 2006). For the contextualization of TPACK, it is important to acknowledge that the focus is on knowledge and not on competencies.

TPACK claims relevance for different functions. In detail, these functions are described as guiding research and curriculum development; offering analytic tools for studying teacher knowledge and educational technology; helping in designing pedagogical strategies; describing a goal of teacher education; and, overall, "contributing, at multiple levels, to theory, pedagogy, methodology, and practice" (Mishra and Koehler 2006, 1046).

With regard to the origin and creation of TPACK, Shulman's (1986) concept of Pedagogical Content Knowledge (PCK) stands out as the predominant research source. Hence, the model works as a link between the tradition of professionalization research and research on media educational science (Endberg 2018). Beyond the reference to Shulman (1986), the authors' experiences and practice significantly shaped the model design. In terms of reception, the impact of the TPACK model is considerable and numerous receptions, adaptations and succeeding works of research prove its high popularity (M. J. Koehler et al. 2014). It is noteworthy that this reception is not limited to the US national context but illustrates the international relevance of TPACK (e.g., Chai et al. 2011; Jordan 2011; Endberg 2018; cf. Chapter 5).

4.2.2 ISTE standards for educators

The ISTE standards for educators are a core outcome of the engagement of the International Society for Technology in Education [ISTE] and "define the digital age skills and pedagogical insights educators need to teach, work and learn" (International Society for Technology in Education [ISTE] n.d.). There are also ISTE standards for the target groups of students, education leaders, and coaches, as well as computational

thinking competencies for educators and ISTE standards for computer science educators.

In their latest 2017 version, the ISTE standards for educators define educators as empowered professionals and as learning catalysts. In the sense of competency fields, there are seven roles educators should fulfill. Three of these roles are grouped under the headline of "empowered professional":

1. learners (educators should engage in professional development and continuously learn and improve their practice),
2. leaders (they should lead in student empowerment and success and in improving teaching and learning), and
3. citizens (they should inspire their students regarding a positive contribution to and responsible participation in the digital world).

The following four roles are summarized under the headline of "learning catalysts":

4. collaborators (they should collaborate with colleagues and students for various purposes),
5. designers (they should design authentic and learner-driven activities and environments),
6. facilitators (they should facilitate student learning with technology to help students achieve the ISTE Standards for Students), and
7. analysts (they should understand and use data for instruction and supportive purposes) (International Society for Technology in Education [ISTE] 2017).

Each of these roles is specified by three to four indicators, such as 4.a) Collaborator: "Dedicate planning time to collaborate with colleagues to create authentic learning experiences that leverage technology" (*ibid.*).

In terms of functions, the ISTE standards aim to facilitate the transformation of learning and teaching and to empower connected learners in a connected world (International Society for Technology in Education [ISTE] n.d.) by offering plain and concrete guidance for educators and for their role understanding. Hence, there is a distinct practical focus, which is a contribution to the improvement of practices in teacher education.

With regard to the relation between ISTE standards and research background, there is a close connection of the standards to a wide range of US sources and selected resources from outside the US. The development methodology of the 2016 version combined a literature review with a focus on scientific research on topics such as empowered student learning, computational thinking or digital citizenship, with consultations with different stakeholder groups and experts and public feedback from the USA and over 50 other nations (International Society for Technology in Education [ISTE] 2016).

As far as the impact is concerned, numerous sources, especially from the US context, give the impression that there is a strong influence of the standards on current practices. Besides the scientific reception and contextualization of the ISTE standards (DeSantis 2016), their indicators are suitable for adoption and application for assessment purposes (cf. Çoklar and Odabaşı 2009; Sharp 2014; Şimşek and Yazar 2016; Grable, Hunt, and Wood 2004; in Germany: Siller 2007). The ISTE standards have also frequently been used as a framework for the evaluation, development and improvement of related study programs (Alghazo 2006; Sutton 2011; Lewis 2015).

4.2.3 NAMLE Core Principles of Media Literacy Education

The National Association for Media Literacy Education [NAMLE] describes itself as a US national organization dedicated to media literacy and to fostering critical thinking, effective communication and empowered media participation (National Association for Media Literacy Education [NAMLE] n.d.). In this context, the NAMLE Core Principles of Media Literacy Education (2007), based on previous scholarship in related fields, were published to "articulate a common ground around which media literacy educators and advocates can coalesce" (*ibid*., p. 1).

The NAMLE Principles basically list six statements and specify them by a number of implications for practice. The six statements are:

1. "Media Literacy Education requires active inquiry and critical thinking about the messages we receive and create";
2. "Media Literacy Education expands the concept of literacy (i.e., reading and writing) to include all forms of media";
3. "Media Literacy Education builds and reinforces skills for learners of all ages. Like print literacy, those skills necessitate integrated, interactive, and repeated practice";
4. "Media Literacy Education develops informed, reflective and engaged participants essential for a democratic society";
5. "Media Literacy Education recognizes that media are a part of culture and function as agents of socialization"; and
6. "Media Literacy Education affirms that people use their individual skills, beliefs and experiences to construct their own meanings from media messages" (*ibid*.).

An example of the implications for practice linked to each of these sentences is 6.1: "MLE is not about teaching students what to think; it is about teaching them how they can arrive at informed choices that are most consistent with their own values" (*ibid*.).

The main functions of the NAMLE Core Principles are fostering dialogue and contributing to the development of clear and measurable outcomes for US schools

(*ibid*.). This is achieved by a focus on the perspective of Media Literacy Education and descriptions of characteristics and guidelines for this discipline, as opposed to the specification of teachers' knowledge, as in TPACK, or competencies, as in the ISTE standards for educators. To this degree, they are not directly relevant for an analysis of educators' competencies. Yet they shape a systematic picture of aspects considered relevant for teaching media literacy in the US and are thus an important source in the context of respective competency models, especially because there is no corresponding scientific model of media literacy competencies for US educators so far.

The NAMLE Core Principles of Media Literacy Education were authored by ten members of NAMLE with a research background in US media literacy, namely Lynda Bergsma, David Considine, Sherri Hope Culver, Renee Hobbs, Amy Jensen, Faith Rogow, Elana Yonah Rosen, Cyndy Scheibe, Sharon Sellers-Clark, and Elizabeth Thoman. Sources used for crafting the document included the international and national works of associations, centers and institutes, e.g., the Association for Media Literacy; political sources, e.g., the Ontario Ministry of Education Media Literacy Resource Guideline; and publications from relevant researchers in the field, which are listed in the publication (National Association for Media Literacy Education [NAMLE] 2007). Hence, there is a strong connection between the NAMLE principles and the national research background amended by international references. Consequently, the reception of the principles has been prominent, especially in their target field of US media literacy education, as, for example, in implementations as described by Rogow (2009) and Kim (2016), or as a basis for the quantification and measurement of media literacy (Arke and Primack 2009).

4.2.4 TETCs

The Teacher Educator Technology Competencies [TETCs] are a recent contribution to the US research discourse. They were published by Foulger, Graziano, Schmidt-Crawford, and Slykhuis in 2017 and describe the technology competencies "*all* teacher educators need in order to support teacher candidates as they prepare to become technology-using teachers" (Foulger et al. 2017, 413).

The TETCs comprise twelve competencies:
– "Teacher educators will design instruction that utilizes content-specific technologies to enhance teaching and learning,
– Teacher educators will incorporate pedagogical approaches that prepare teacher candidates to effectively use technology,
– Teacher educators will support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching with technology in their content area,
– Teacher educators will use online tools to enhance teaching and learning,

– Teacher educators will use technology to differentiate instruction to meet diverse learning needs,
– Teacher educators will use appropriate technology tools for assessment,
– Teacher educators will use effective strategies for teaching online and/or blended/hybrid learning environments,
– Teacher educators will use technology to connect globally with a variety of regions and cultures,
– Teacher educators will address the legal, ethical, and socially-responsible use of technology in education,
– Teacher educators will engage in ongoing professional development and networking activities to improve the integration of technology in teaching,
– Teacher educators will engage in leadership and advocacy for using technology, and
– Teacher educators will apply basic troubleshooting skills to resolve technology issues" (Foulger et al. 2017, 432–33).

As in the case of most of the other models and guidelines introduced, the overall function of the TETCs is directed towards the improvement of initial teacher education practices. This function is specified explicitly: the authors support the vision of a comprehensive infusion of technology into the whole teacher education curricula, as opposed to stand-alone educational technology courses (i.e., Technology Infusion Approach; Foulger et al. 2017; Foulger, Wetzel, and Buss 2019), and the TETCs are designed as an instrument for fostering this development and for offering a reference for all teacher educators to become competent in the field of educational technology.

The TETCs are well-founded in primarily national research; they were developed deductively from a wide range of sources and validated with the help of experts (Foulger et al. 2017). Hence, they are strongly rooted in the US national research context and are designed to contribute significant research input for systematic improvements. There is a political dimension of the efforts, too, given that the TETCs were also developed to answer policy claims in the National Education Technology Plan from 2017 (*ibid*.). It is noteworthy that in comparison to the other models and guidelines introduced, their focus is on teacher educators instead of preservice or inservice teachers. This way, they broaden the field of research and contribute another important facet to the overall scientific discourse. Due to their recent publication, the TETCs are referred to in scientific sources mainly by the authors and by other members of the Society for Information Technology and Teacher Education (SITE) – the society where the TETCs were primarily introduced and discussed so far, as, for example, in Graziano, Foulger, Schmidt-Crawford, and Slykhuis (2017) or in Knezek and Christensen (2019).

4.2.5   Interim conclusion on US models of media-related educational competencies
A contextualization and juxtaposition of these four models and guidelines from the USA reveals insightful comparative conclusions. The comparison criteria focused on were authorship, structure and content focus, function, and impact and connection to research background.

Authorship of the US models point to a certain role of professional associations and societies in the context of competency modeling in the US: both the ISTE standards and the NAMLE Core Principles of Media Literacy Education indicate the connection to their respective association in their very names, and while the TETCs are published by four researchers, their connection to the SITE is evident, given that the competency framework was discussed with SITE participants, was first published at a SITE conference (Foulger et al. 2017), and is referred to in a number of papers from SITE Proceedings (Knezek and Christensen 2019; Carpenter et al. 2019). TPACK appears as the only framework without an evident connection to a society or association. While the models and standards selected for this overview are not exhaustive, their contextualization yet implies that professional societies in the USA play an important role in the development and establishment of impactful frameworks.

There are differences on a structural level between TPACK, on one hand, and the ISTE standards, NAMLE Principles and TETCs, on the other. TPACK has a model structure with three main dimensions and their intersections, while the other three frameworks are designed as lists with headlines or main aspects with additional explanations and clarifications. These different structures bring about obviously different levels of detail inherent in the basic model. Additionally, in terms of content, the four models show clearly diverging foci. As has been argued above and will be more deeply explored in Chapter 5, TPACK has a narrow focus on the knowledge domains needed for an educational implementation of digital media into teaching and learning contexts. In comparison to that, the ISTE standards assume a broader perspective and provide guidance on practical competencies needed by educators for teaching and learning contexts with a certain focus on the educational technology perspective. The NAMLE Core Principles, on the contrary, emphasize a media literacy perspective with a focus on educational processes instead of educators' competencies; and the TETCs add a view on the dimension of teacher educators, also focusing on educational technology competencies. There are a number of cross-references between these four frameworks. For example, there are connections evident between the ISTE Standards and the NAMLE Core Principles: in statement 6.2 from the NAMLE Core Principle, it says "MLE helps students become aware of and reflect on the meaning that they make of media messages, including how the meaning they make relates to their own values" (National Association for Media Literacy Education [NAMLE] 2007, 5), which corresponds to ISTE standard 3b: Educators "establish a learning culture that promotes curiosity and critical examination of online resources and fosters

digital literacy and media fluency" (International Society for Teaching in Education [ISTE] 2017). However, their perspectives differ significantly; the ISTE standards are oriented towards educators' competencies or skills while the NAMLE standards are focused on educational processes. Also, DeSantis (2016) points out certain overlaps of the ISTE standards and TPACK but cannot confirm a relationship between TPACK and ISTE proficiencies of preservice teachers in a study. The authors of the TETCs emphasize the importance and impact of the ISTE standards but conclude that it is necessary to develop a separate framework with a specific focus on teacher educators. This brief overview of contents illustrates that the four frameworks emphasize different foci and are separated by disciplinary orientation and target groups.

Consequently, the four models share central functions in terms of a contribution to, and systematization of, media-related education, but they assume different viewpoints. They also have different target groups, as they address either preservice teachers (TPACK), inservice teachers (ISTE standards and NAMLE Core Principles), or teacher educators (TETCs). The guideline characteristics of the ISTE standards, the NAMLE Core Principles and also the concrete formulations in the TETCs facilitate a direct and user-friendly application in a variety of educational processes as a means of orientation, reference and structure, while TPACK requires further specifications due to its broad and open design, but can also be used in the functions of an orientation and reference framework.

A view into literature and practice reveals that these functions are realized and have an impact on the respective backgrounds to varying degrees. TPACK is particularly widely used not only in the US but beyond, especially for measurement and reference purposes, while the ISTE standards stand out with their relevance in the alignment and systematic structuring of initial teacher education curricula in the US. The NAMLE Principles are mainly used as a reference for media literacy education in the US, albeit on a less binding level if compared to the ISTE standards, which also shape some state standards (cf. Chapter 10.2.2). The TETCs, which are quite recent, are still being researched and thus have the lowest impact on research background in comparison to the other frameworks but receive growing scientific awareness, as described above. This finding is related to the connection of the four frameworks to their own backgrounds. It is noteworthy that TPACK, the ISTE standards, the NAMLE Core Principles and the TETCs explicitly build on US national sources with selected references to international resources.

Overall, the differing foci can be read to imply that the four frameworks generally complement each other because they all contribute to forming one comprehensive picture of media-related education in the US. Against the background of the lower level of detail inherent in TPACK, it is noteworthy that this model appears to have the highest international impact. The role that TPACK plays in international contexts and its characteristic focus in the light of other models will be elaborated in Chapter 5.

4.3 German Models

In Germany, there is a tradition of a lively pedagogical discourse which, as described in Chapter 2, encompasses a considerable amount of research focused on teachers' *Medienkompetenzen* [media competencies]. It focused on the term *medienpädagogische Kompetenzen* [media pedagogical competencies] in the 1990s when different research projects led to the conclusion that teachers need skills beyond their own use and application of digital media, such as the design of media-enhanced learning environments or the integration of media education into the genuine pedagogical frame (Baacke 1995; Tulodziecki 1995; 2012). However, research related to *medienpädagogische Kompetenzen* and according models received less attention for a long time (Kammerl and Mayrberger 2011). As Siller (2007) points out, this is due to chronology – a focus on media competencies was the basis upon which there was increasingly more research on *medienpädagogische Kompetenzen* being conducted in a second step –, and also due to difficulties in the conception of *medienpädagogische Kompetenz*. In 2007, the author described the dialogue about groundwork in this field as only at its beginning, an assumption that can be questioned critically against the background of the important and influential approaches that date back to the 1990s and will be introduced in the following section. It can be said that a lot of work has been done in this field in the last few decades, but it has not yet brought forward a consensus on a definition or a universal model. The following selected models from this field illustrate the varieties and different foci that models of media-related educational competence have been adopting.

4.3.1 Tulodziecki

An early contribution to the German research field and an important milestone in the German discourse on *Medienpädagogische Kompetenzen* are the five target areas of media pedagogy proposed by Tulodziecki and Blömeke (1997), German educational researchers working in the field of initial teacher education. The target areas claim that teachers should be ready and able (1) to demonstrate media competence themselves; (2) to understand the significance of media in the lives of children and youths and to include them in their teaching with and about media; (3) to assess media offerings regarding their appropriateness for lessons and to develop their own contributions to teaching and learning processes and to plan, realize and evaluate according teaching units; (4) to realize media-related educational tasks in lessons and in mentoring; and (5) to understand and influence school-related conditions of working with media (such as personal or organizational) and to contribute to media-pedagogical concepts in the sense of school reform (Tulodziecki 2012).

Based on his earlier works, on respective project work in Paderborn (e.g., 1997a; 1997b; 1997c; 1998; 1999; Moll and Tulodziecki 2000) and the wider German national

research background, Tulodziecki further suggests standards for *medienpädagogische Kompetenzen* in teacher education. He defines *standards* as an expression of competencies that should be reached at a certain point in initial teacher education (2012; in conformity with Klieme et al. 2003) and explains in detail the model that is the basis of his standards.

Tulodziecki's (2012) model of teachers' *medienpädagogische Kompetenzen* includes three main target areas, which are (1) the use of media for the stimulation and support of learning processes, (2) the realization of media-related educational tasks, and (3) the development of media pedagogical concepts in school (p. 282). Each of these areas further comprises five competency aspects, which are

– understanding and assessing conditions for media pedagogical actions (on an individual, societal and historical level);
– characterizing and assessing theoretical approaches for media pedagogical actions (from an empirical and normative perspective and/or with regards to a possible realization);
– analyzing and assessing examples of media pedagogical actions (with regards to preconditions and objectives as well as procedures and devices);
– developing own suggestions for media pedagogical actions, based on theory (including the description of objectives, under consideration of preconditions and including plans about appropriate procedures and devices); and
– testing and evaluating theory-based examples for media pedagogical actions (collecting, analyzing and interpreting data; pp. 283-284).

Tulodziecki (2012) also provides examples of standards to specify each of these competency aspects for each area, while pointing out that these are examples only and need to be adapted with regard to specific conditions such as the state, university, or study program for which the standards are required.

In a more recent contribution, Tulodziecki (2017) refines and amends this model. Based on his earlier considerations and also taking into account the M³K model (Herzig et al. 2015), which shows strong references to Tulodziecki's (2012) model, he aspires to shape a curricular framework for media pedagogical studies, including relevant topics and contents. This framework includes four competency fields, which are (1) Learning and teaching with media/in digital environments, (2) Realizing educational and mentoring activities in the context of mediatization and digitalization, (3) Developing and evaluating projects or teaching-learning-units for learning about media (including digital basics), and (4) Improving institutional frame conditions for media pedagogical actions (Tulodziecki 2017, 7). Obviously, the three competency areas as defined in 2012 were reformulated and restructured to include "(3) Developing and evaluating projects or teaching-learning-units for learning about media (including digital basics)," which was not a distinct competency area before. The five

competency aspects, on the other hand, were retained in their original definition, except for the second one, "characterizing and assessing theoretical approaches for media pedagogical actions," which has been differentiated as "characterizing and assessing theoretical approaches about and empirical research on media pedagogical actions" (*ibid.*).

In terms of functions, the overall context of Tulodziecki's works contributes to the systematic foundation of (German) teacher education by providing a structured reference frame. In this context, the competency model serves as a foundation for the formulation of sound standards which can then contribute to systematic advancements through the functions of evaluation, orientation, qualification, curriculum, reform, professionalization, and certification (Tulodziecki 2012).

There is a strong link between Tulodziecki's works and the national German research context. References to numerous German authors from this field are constantly included and integrated, and other important German educational researchers build on Tulodziecki's works as well (e.g., Blömeke 2000; Herzig et al. 2015; Spanhel 2017). Consequently, Tulodziecki's works on models of *Medienpädagogische Kompetenz* can be considered central sources within the national German research discourse on media-related educational competencies.

4.3.2 Blömeke

Besides the early concepts of *medienpädagogische Kompetenz* introduced by Tulodziecki, as described above, further related concepts were introduced by Baacke (e.g., 1973; 1987; 1994; 1996a; 1996b; 1999) and Schulz-Zander (e.g., 1997). The three approaches of Tulodziecki, Baacke and Schulz-Zander share a significant number of central characteristics which have been summarized and synthesized by Blömeke (2000) into a comprehensive deductive model. Hence, it appears functional to include Blömeke's (2000) model as a representation of and conclusion from the formerly mentioned three approaches.

The author abstracts five core areas of *Medienpädagogische Kompetenzen* which are part of all three approaches. These five areas are:
1. Media didactical competence, defined as the ability to use media and information technology in appropriate teaching and learning formats in a reflected way and to further develop them;
2. Media educational competence, defined as the ability to cover media-related topics in the sense of pedagogical principles in school;
3. Socialization-related competence in media contexts, defined as the ability to consider learning conditions constructively during media pedagogical actions;
4. School reform competence in media contexts, defined as the ability to design the conditions of media pedagogical acting innovatively; and

5. Own media competence, defined as the ability for appropriate, self-determined, creative and socially responsible acting in the context of media and information technologies (Blömeke 2000).

All five competency areas comprise two or three competency aspects.

According to Blömeke (2000), it is necessary for teachers to have *medienpädagogische Kompetenzen* in order to be able to facilitate their students' acquisition of media competencies, which is considered a fundamental and important task of schools (cf. also Blömeke 2003; Siller 2007). The overall purpose of Blömeke's work has been summarized as a contribution towards the shaping of a profile of media pedagogy in teacher education. The definition of contents and learning objectives relevant for media pedagogy are linked to the question of ways to anchor them in teacher education (*ibid.*).

The close connection between Blömeke's model and the German research background has been emphasized above in the context of model sources. It is worth mentioning that the resulting model also had a strong mutual impact, as it has been considered a basis for most subsequent German developments (Siller 2007).

4.3.3 Bremer

One of the approaches that developed on the basis of Blömeke's and Tulodziecki's earlier works has been published by Bremer (2011a) in the context of a state-wide initiative based on political support in the state of Hesse. Against the background of research and former German approaches, Bremer (2011a) postulates six competency areas:

1. Content-related competencies: instrumental-pragmatic basics (preservice teachers have learned to used media effectively for supporting their own learning in their studies);
2. Content-related competencies: theoretical basics (preservice teachers have learned to differentiate and delimit scenarios for new media in educational processes with regard to their various potential conducive to learning, and to evaluate the model functions of new media and to illustrate these by examples from their subjects);
3. Content-related competencies: using media in class (preservice teachers have learned to use new media in educational processes to achieve new ways of illustrating and fostering understanding, to organize the use of new media in educational processes to encourage learners' self-organization and self-dependence, and to advocate the pedagogical meaningfulness of media-use scenarios they developed);

4. Process-related competencies: the ability to work in a (heterogeneous) team in media-related contexts;

5. Process-related competencies: mediation skills (preservice teachers have learned to impart knowledge and skills related to new media in a way that others may learn from); and

6. Process-related competencies: auto-didactic competence (preservice teachers have learned to assess developments in the field of new media to derive their own need for continuing education).

The author introduces a model of *medienpädagogische Kompetenzen* for preservice teachers in the German federal state of Hesse. Notably, this model has a distinct practical focus and relevance, as it was developed on the initiative of and with support by the state Hesse, in the context of the development of a state-wide concept for *Medienkompetenz* in teacher education for all phases of teacher education: university initial teacher education, practical teacher education at school, and continuous professional development (Arbeitsgruppe "Neue Medien in der universitären Lehrerbildung" 2004).

Against the background of the formerly mentioned sources, the imprecise use of terminology in Bremer's approach stands out. The author speaks about *Medienkompetenz*, but the competencies described go beyond media competence and clearly refer to *medienpädagogische Kompetenzen*, a term that is also inconsistently used throughout the document. Additionally, the concept that emerged from the project based on the competency model is called "Medienbildungskompetenz für Lehrende," which translates as "Media education competence for teachers," and is a third related term used without definition or clear distinction to *Medienkompetenz* or *medienpädagogische Kompetenzen* (cf. Tulodziecki 2010; 2011). This adds to the conceptual lack of precision.

As pointed out above, Bremer's (2011a) competency model was influential particularly in the context of teacher education in the state of Hesse and served as a basis for the development of a competency certificate for preservice teachers at Goethe-Universität Frankfurt and of a media education concept for all preservice teachers in Hesse (Bremer 2011b).

4.3.4 M³K

The M³K project was a three-year German research project running from 2013 to 2015, conducted by four university partners and research institutions and funded by the German Federal Ministry of Education and Research. Its main objective was modeling and empirically validating a competency model of *medienpädagogische Kompetenz*.

In the M³K model, *Medienpädagogische Kompetenz* is basically understood as an interplay of the three main competency fields of *Mediendidaktik* (teaching with media), *Medienerziehung* (teaching about media) and *Medienbezogene Schulentwicklung* (media-related school reform). In addition to this, technological knowledge and non-cognitive facets, i.e., beliefs and perceived self-efficacy, are understood as important and conducive basic aspects having an impact on respective *medienpädagogische Kompetenzen* (Herzig and Martin 2018).

Based on this fundamental understanding, competency aspects amend the three main areas and thus shape a matrix: at the upper axis, there are the three main areas, i.e. *Mediendidaktik* (teaching with media), *Medienerziehung* (teaching about media) and *Medienbezogene Schulentwicklung* (media-related school reform). Five competency aspects form the vertical axis. These competency aspects are (a) understanding and assessing conditions, (b) describing and evaluating theoretical approaches, (c) analyzing and evaluating examples, (d) developing one's own theory-based suggestions, and (e) implementing and evaluating theory-based examples. Each field between the two axes is filled with standards that specify the competency outcomes. For example, the two standards in the field of media education for the competency aspect of "describing and evaluating theoretical approaches" are: "Student teachers are able to describe concepts of media education and related empirical findings appropriately," and "Student teachers are able to assess concepts from an empirical, normative or practical perspective" (Herzig et al. 2015; Tiede and Grafe 2016; Herzig et al. 2016). In most cases, these standards are further differentiated.

Beyond a grounded contribution to research on *medienpädagogische Kompetenz* and respective systematic advancements for German teacher education, the functions of the M³K model also include forming a suitable basis for the respective competency measurement which can then help validate the model (Herzig et al. 2015).

Against the background of the German research approaches outlined above, it is evident that the M³K model has been derived deductively, building primarily on established national sources such as the works of Tulodziecki and Blömeke. For example, a clear connection to Blömeke (2000) and Tulodziecki (2012) is visible in the assignment of media didactics/teaching with media, media education/teaching about media, and media-related school reform as the three main areas of competencies. Also, the five aspects of competencies represented in the left axis of the matrix, and the overall structure of a matrix, resemble the ideas postulated by Tulodziecki (2012). These parallels stem from the overall intention of the M³K project to develop a deductively and inductively reasoned and empirically validated structural model (Herzig et al. 2016), and they suggest a thorough literature review be performed in the development process and illustrate the role of the M³K model as an advancement of the Paderborn approach significantly shaped by Tulodziecki, as described above. The attempt to both model and empirically measure the competence in question

represents the innovative approach in the M³K project because such a validation is novel to the German research context so far (*ibid.*). The scientific reception of the M³K model includes references in related literature (Goetz 2018; Goecke, Stiller, and Pech 2018), further model developments (Tulodziecki 2017), international comparative analyses (Tiede and Grafe 2016; 2019) and an orientation of teacher education curricula in single institutions (Tiede and Grafe 2019; cf. Chapter 11.2).

4.3.5 Interim conclusion on German models of media-related educational competencies

Overall, the four German models of *medienpädagogische Kompetenz* introduced reveal both parallels and mutual references, as well as a number of differences with regards to the criteria of authorship, structure and content focus, function, and impact and connection to research background.

In terms of authorship, they have all been published by educational researchers with a university background, either based on individual works (Blömeke) or on a project context (Tulodziecki, Bremer, M³K), which brings about funding and, consequently, the interests of further funding stakeholders. Again, all four models build explicitly on national German sources and thus overlap. Consequently, the structures of the four frameworks are similar: all of them list basic competency areas which are then explained or specified by standards.

Considering their contents, they are all, with the exception of Bremer's (2011a) model, connected by the basic idea of teaching with media and teaching about media as two core dimensions of *medienpädagogische Kompetenz* and of a media-related school reform competence. Further aspects that shape all approaches to varying degrees are the notions of social competencies and of own technological skills – even though the roles of such aspects differ. For example, while they are an inherent part of Blömeke's (2000) model, they are considered to be either integrated, as in the case of social competencies, or a correlate, as in the case of technological knowledge in M³K. In relation to the other approaches, it is evident that Bremer's deviates, for example, from Tulodziecki's and Blömeke's models by shifting emphases. The notion of media educational competency, i.e., competencies in teaching about media, is rather neglected, while the media didactical, social and technical perspectives are stressed.

All of the four models are united by their objective to contribute to the context of German initial teacher education and to provide a framework to fulfill numerous functions in this context, such as orientation and guidance.

However, the scope of actual influence varies: while Tulodziecki's and Blömeke's works are considered to be core groundwork for most respective publications and developments in German-speaking countries, the influence of Bremer's model appears mainly limited to the state of Hesse. Out of the selection, M³K is the only model that

was analyzed and exploratorily tested against an international background (Tiede and Grafe 2016; 2019) but has received limited impact on actual practices in Germany so far, a fact that might also be linked to the non-finalized validation of the measurement instrument (Herzig et al. 2015; Endberg 2018). A noteworthy observation concerning the links of the introduced German competency models to their national research background is the fact that they are all closely linked and build on each other. While setting their own emphases, as in the case of Bremer's model, they all share the basic idea of a construct of *Medienpädagogische Kompetenz* and include competency areas as structural means.

4.4 Interim Conclusion on the Overview of Models of Media-related Educational Competencies from Three Different Contexts

All in all, the brief overview in this chapter of selected models and frameworks of media-related educational competencies from international contexts, the USA and Germany offers an introductory approach to the complex field of competency modeling and allows for first conclusions regarding the first research question: "Which central models of media-related educational competencies are there in German and US research, and what are their shared characteristics and differences?" In favor of a systematic and comprehensive approach, these characteristics and differences were specified to the categories of author and background, structure and main contents summarized, model function, and impact and connection to the research background.

The consideration of model authorships proves that different stakeholders can be involved in the process of competency modeling. As one might expect, most of the authors of the models introduced have a research and university background. In the US context, a certain tendency of organizing the modeling process via professional associations was discovered, whereas individual approaches led to the design of German models, and formal project structures shaped the frame for international and German models. In the case of such formal project structures, researchers as authors sometimes worked together with industry partners, as in the case of the international approaches eTQF and UNESCO ICT CFT and, through funding, also embraced a political perspective which dominates international approaches in particular and shapes a perspective of broad applicability of the resulting models.

The contents of the models vary clearly, although there are certain links, either explicitly – as in the case of the M³K model, which has been described by the authors to build, e.g., on Blömeke's (2000) model (Herzig et al. 2016) – or indirectly, as in the case of the ISTE standards and TPACK, which share certain assumptions and aspects. DigCompEdu stands out in this context because of its clear disclosure of sources that included a wide range of national and international approaches. However, it

has also become obvious that there are significant divergences between some competency models, rooted in different structures, perspectives and foci. In the case of the US, some of the approaches introduced hardly had any assumptions in common; for example, the ISTE standards aim at supporting teachers in the media-enhanced transformation of teaching and learning, while the NAMLE standards are targeted at the facilitation of media literacy education. The disciplinary distinction between the perspectives of media literacy and educational technology contributes significantly to the models being focused rather narrowly. The international models introduced, however, share a certain emphasis on comparable competencies. Likewise, the German sources were closely interconnected by a shared concept of *Medienpädagogische Kompetenz* and by building on Tulodziecki's and Blömeke's works in particular.

Also, on a structural level, the approaches introduced from the US varied due to the inclusion of standards and guidelines as opposed to research-based scientific competency models, as in the international and German frameworks. This inclusion of standards and guidelines was considered necessary due to a lack of respective research-based competency models and also due to the relevance of the ISTE standards and the NAMLE Core Principles of Media Literacy Education for the context of media-related teacher education in the US. The design of these standards brings about a direct applicability in educational contexts. Overall, all of the approaches introduced were connected by the general function to contribute to initial teacher education or educational contexts in a more general frame by providing a structure for orientation and guidance. As pointed out, the impact varies from local realizations, as in the case of M^3K, to national relevance, as in the case of the NAMLE Principles, and to a wide international application, as can be seen with DigCompEdu.

However, the impact achieved by the different models introduced cannot fully be explained by the overview provided. While it is obvious that an international model such as DigCompEdu, funded and supported by the European Commission, is likely to achieve a larger impact compared to a national and non-English model such as M^3K, it is still questionable how the model characteristics are connected, how far single models from different research backgrounds can be contextualized, and what can be learned from such a contextualization. Hence, against the background of the introductory comparative observations mentioned above, it is now consistent to consider a selection of models in greater depth and to apply a structured methodology for researching these and other decisive model features, based on related literature and research. Such a methodology will be developed and applied in the following chapter, which introduces a differentiated systematic comparison of three selected models of media-related educational competencies.

5.   Systematic International Comparison of Competency Models

5.1   Model Comparison Methodology

5.1.1   Research Approach and Procedure

The research interest of the following chapter corresponds to the second part of the research question introduced in the beginning: "Which central models of media-related educational competencies are there in German and US research, and what are their shared characteristics and differences?" In favor of a well-grounded conclusion on such characteristics and differences, it is useful to apply a systematic comparison building on the previous chapter to analyze shared characteristics and differences of selected competency models and thus to ultimately achieve an enhanced understanding of what competency modeling means and comprises. The discipline of comparative education offers a variety of methodological approaches for comparisons serving different purposes. Theisen and Adams (1990; cf. also Phillips 2006) suggest differentiating between analytical, descriptive, evaluative, and exploratory research types. Analytical research serves to describe roles, to specify cause-and-effect relations or to explain relations and consequences; descriptive research describes phenomena or conditions and relations between variables; evaluative research judges the merit, value, or worth of a program or technique and facilitates interpretations useful for decision making; and exploratory research aims to generate new hypotheses or questions and explores relationships and functions with potential for in-depth research (for an overview of methods, cf. also Phillips and Schweisfurth 2006; Bray, Adamson, and Mason 2007; Khakpour 2012). The methodological approach applied in the following can be allocated to the analytical research methodology as described by Theisen and Adams (1990) because the relationship between competency aspects and their meaning for the whole model will be focused on from an analytical stance.

A concrete approach from the field of analytical research, which has become a standard of reference within German comparative educational research, has been postulated by Hilker (1962). For the procedure of systematic comparisons, the author suggests four steps: 1) Description, in the sense of a baseline study to investigate the objects in question by means of own observations and/or literature; 2) Interpretation, as an explicative analysis against the background of historical and societal conditions; 3) Juxtaposition, as a first step of comparison, where the pedagogical phenomena in question are considered side by side with respect to pre-defined criteria; and 4) Comparison, as a second step of comparison, where consistent criteria for evaluation are developed on a superordinate level and where theory-based hypotheses may be developed (1962; summarized in Adick 2008). This approach is

considered applicable for the following analysis because it allows for a systematic and analytical comparison of models and model characteristics, it offers a step-by-step procedure and it is well-established within German research. Its proximity to Bereday's (1964) often used approach (Adick 2018) suggests a suitability also for international comparative contexts.

However, Adick (2008) also thematizes a critique which has been addressed to Hilker's approach regarding the inductive nature of his procedure. The approach takes a beginning in empirical findings and claims the development of a comparison in the course of the process. The conclusion and hypotheses at the end stem from single empirical observations, although it does not logically make sense to make inferences about regularities from single observations. To meet this critique and to achieve a sound methodology, certain adoptions were made in the following by an emphasis put on the pre-definition of comparison criteria. Hence, the comparison of the models was preceded by an exhaustive literature review in the field of competency modeling in order to clear main functions and characteristics of competency models. In this context, central sources include Hartig and Klieme (2006), Klieme and Hartig (2007), Artelt and Schneider (2011), Neumann (2013), and the taxonomy of cognitive skills (Bloom and Krathwohl 1956; Anderson and Krathwohl 2001). The model characteristics specified in these works relate to a variety of aspects, and competency models are described from different perspectives. On this basis, the findings were classified, and categories were deducted to achieve a comprehensive approach that takes into account the state of research. These categories are 1) background, 2) methodology/model genesis, 3) structure, and 4) contents.

In the analysis, the four steps of comparison as suggested by Hilker (1962) were performed successively to ensure a technically sound analysis: after the literature review and the genesis of criteria based on this review, the models were first described separately, then interpreted, then juxtaposed and only then compared. However, the adoption of Hilker's approach in terms of a category-based procedure applied throughout these four steps suggests an according structure also for the presentation of results. Therefore, the following chapter will draw findings together following the structure of the deductively developed categories. It will first describe each of the three models in the study with respect to a category and then integrate findings on a comparative and interpretative level. Such an approach will help avoid redundancies and achieve an adequate and coherent presentation in accordance with the category-based procedure.

5.1.2 Selection of Models

The presentation in Chapter 4 of relevant models from the three areas of interest, i.e., international, US, and German contexts, provides a sound basis for a grounded decision regarding suitable objects for the succeeding in-depth analysis. Based on relevant literature regarding competency model features, characteristics and examples, this decision was informed by the following criteria: 1) Innovative potential of the model: does it contribute something new to its national or even international research background?, 2) Impact: is the model recognized and well-established?, 3) Measurement instruments: are there measurement instruments existent or in development?, and 4) Validation: is the model well-grounded and validated?

A fifth aspect did not directly influence the selection of models but rather served as a criterion to evaluate and confirm the final selection, namely the principle of maximum contrast (Przyborski and Wohlrab-Sahr 2014): do the models selected display a variety of cases, i.e., are they different from each other and cover diverse backgrounds and characteristics? Such a maximum contrast of examined cases is helpful to ensure a wide coverage of the field of research, and while a number of cases as low as three can hardly display all facets of a field, it is yet desirable to aim for contrasts and to include variety.

In accordance with the focus of this work, a competency model from Germany and one from a US background were included in the sample. However, as became evident in the first comparative remarks in Chapter 4, it is worthwhile to also consider the level of international competency modeling due to its special predicaments in terms of conditions, background and impact. International models may serve as a shared reference for different national models, and their approach is valuable to take into consideration as well. Hence, it was decided to add an international model as a third source to the sample.

On this basis, the following three models were selected for the comparison: the German M³K model, the US American TPACK model, and the European DigComp-Edu model. Notably, neither of these models excels in each of the four selective aspects pointed out earlier, but all of them have characteristics that qualify them for the purpose of comparison. M³K has innovative potential, because it summarizes, amends and reshapes former approaches in the field and adds new methods. Its innovative potential is closely linked to its validation because the distinctive feature of this model, which sets it apart from its context of German pedagogical research literature, is the exhaustive validation process performed in the course of its development. Hence, it is appropriate to include this model, even if the impact is still comparably low due to its being quite recent, and although a measurement instrument is under development but has not been validated and published yet.

The distinctive feature of TPACK is its high impact, because "amongst the similar and related approaches, the TPACK framework has received the most traction

in research and in professional development approaches, as evidenced by over 600 journal articles about TPACK" (Koehler et al. 2014, 102). Its popularity led to a variety of model developments, validation studies and measurement instruments, and while the model validity has been challenged repeatedly (e.g., Archambault and Barnett 2010; Lux, Bangert, and Whittier 2011), the overall reception and validation of TPACK can be understood to be confirmative and qualifies TPACK for a consideration in the context of this comparison.

Finally, DigCompEdu was selected because of its high innovative potential and comprehensive research background. The model is based on a variety of international media-related competency frameworks and includes works mostly from Europe, but also beyond. As it was published only recently, the impact is still low but is increasing quickly, and a measurement instrument has already been developed.

As these considerations reveal, each of the three models selected has a distinctive feature that sets it apart and justifies its use in the following comparison. The fact that these features all refer to a different criterion – M³K is exceptional with regards to its validation process, TPACK has a particularly high impact, and DigCompEdu has a unique international research background – is consistent with the claim of maximum contrast.

5.1.3 Genesis of Analysis Categories

The analysis categories of background, model genesis, structure and contents comprise a range of aspects that will be introduced in the following.

Background

The aspects in this category illustrate where the models come from and what their basic intention is. The following aspects were selected: Date of publication, because it helps to assess the publicity and potential impact and reception of the models; their authorship, which is particularly revealing with regards to the background of authors (e.g., scientific, political, economic, etc.); national vs. international orientation; target groups; and main objectives or functions.

In general, the potential functions of competency models are multifold. On a systemic level, they offer a standard reference for political, content didactical and school practice-oriented discourses and thus contribute to the generation of political or administrative control knowledge. On the level of schools and lessons, competency models allow for criterial comparisons and help educators evaluate and optimize their competencies. They are an important means for measuring and evaluating the results of learning and teaching processes and thus facilitate pedagogical interventions. They inform school development processes, e.g., in terms of curriculum

revisions or development, and contribute to professionalization. On the level of individual diagnosis, competency models can, for example, support formative evaluations (Pant 2013; Tulodziecki and Grafe 2019).

Model genesis

In general, competence models may be developed *a priori*, which means that they are developed based on theory and operationalized into test items before data gathering processes, or *post hoc*, meaning that they categorize empirical findings or that a phenomenon was discovered in practice and described afterward, as opposed to a systematic development on the basis of theory (Kauertz, Neumann, and Haertig 2012; I. Neumann 2011). This differentiation shows close reference also to the possible differentiation between inductive and deductive strategies for modeling competencies: according to Schaper (Schaper 2009a; 2009b), an inductive approach means generating the model based on empirical analysis, while a deductive procedure builds on existing competency categories based on theoretical models. From a research perspective, *a priori* models are often considered more valuable for a number of reasons. They have a broader basis and include more aspects than those found in a specific test group, they are empirically tested, and they have a higher re-test reliability (Kauertz, Neumann, and Haertig 2012; I. Neumann 2011). Schaper (2009b) suggests a combination of methods as the most adequate procedure for modeling competencies.

A further aspect of model genesis refers to the model validation. According to Schaper (2009b), all models, whether derived inductively or deductively, are hypothetical constructs and thus require validation. This process may include content validation to test whether the competency facets identified represent the field of interest appropriately, construct validation to verify that the model and its operationalization measure the construct intended, and criterion validation to test whether the results of a measurement correlate with results from the measurement of a corresponding characteristic.

Structure

Type of model and overall structure

Based on Klieme and Hartig (2007), Artelt and Schneider (2011) suggest a differentiation between *Kompetenzstrukturmodelle* (structural competency models) and *Kompetenzniveaumodelle* (competency level models). Structural competency models focus on the relationship between latent competency constructs or, as Hartig and

Klieme (2006) phrase it, on the dimensionality of competencies: these models describe which dimensions of a competence can be differentiated, their characteristics and their relationship. Competency level models, on the other hand, scale and quantify competencies. Assuming that competence is a continuum, these models abstract levels which summarize a certain level of competency. Thus, these models also describe the specific skills linked to different occurrences of single competencies: the levels indicate, for example, which demands a person with a high competency will meet and which results a person with a low competency can still achieve (Artelt and Schneider 2011; Hartig and Klieme 2006). Schaper (2009b) adds *Kompetenzentwicklungsmodelle* (competency development models) as a third category for models describing the stages or sequences in which competencies should be acquired in an effective process of competency acquisition. Thus, competency development models primarily serve to evaluate and classify learning achievements and to derive requirements for further development. However, the author points out a lack of competency development models in research on teacher education, and Winther (2011; 2016) similarly argues that elaborate models of this kind are scarce. Overall, competency level models and competency development models appear to share important characteristics in terms of a differentiation of proficiency. They also apply different foci (determining fixed stages vs. evaluating a learning process) while assuming a comparable model structure. Based on this proximity of structures, the model types introduced can be assumed to be non-selective in certain cases, i.e., they overlap and share characteristics. This is particularly true for the role of levels which ascertain a specific status but represent a developmental perspective at the same time.

Level of detail

According to Neumann (2013), competency models serve to structure a competence into different sub-competencies and describe different levels of competence with respect to these sub-competencies. Models vary with regard to the number of sub-competencies and the grain size of the competence levels, i.e., the differentiation of the scale that measures the competence levels. These two characteristics define the level of detail of a competence model. Strictly speaking, Neumann's (2013) classifications refer to competency models and would thus exclude an application to TPACK, which describes knowledge domains. However, the classification makes sense also in the context of modeling knowledge domains because of structural similarities in both types of model.

Against this background, the following basic classification was defined for the following comparison: a low level of detail indicates that a model describes few sub-competencies and does not include a scale for measuring competence levels. A medium level of detail refers to models that offer a more elaborate set of

sub-competencies but no or only a basic scale for measuring competence levels. A high level of detail means that models include a large number of sub-competencies and a detailed scale for competency levels.

Contents

Topic and terminology

The literature review revealed that topics and terminology of related models vary from case to case. While they are all connected by their reference to media-related educational competencies, the terminology for the underlying construct ranges from "competence" (as in DigCompEdu) and "competencies" (as in M³K, eTQF or UNESCO ICT-CFT) to "literacy" (as in the MIL curriculum or the NAMLE Core Principles) or "knowledge domains" (as in TPACK). They refer to either "digital" (as in DigCompEdu), to "media" (as in M³K or the NAMLE Core Principles), to "media and information" (as in the MIL curriculum), to "ICT" (as in eTQF and UNESCO ICT-CFT) or to "technology, pedagogy, and content" (as in TPACK).

As these terms represent constructs, their definitions vary but are related. As argued in Chapter 2, the concept of competence in particular has been subject to various definitional approaches and has been understood in varying ways. With regard to the interdependency of *knowledge* and *competence/competency*, for example, some approaches from the background of cognitive psychology define knowledge as a component of competence (Weinert 2001) or even define competence or competency as knowledge, as in Simonton (2003), Mayer (2003) or Csapó (2004; for a comprehensive overview on concepts of competence, cf. Klieme and Hartig 2007).

Aspects, areas and fields

To contextualize the contents of the three models, it makes sense to approach their competency aspects by means of pre-structured categories in order to maintain an independent viewpoint and to follow the idea of *tertia comparationis*. Hence, the following categories were developed heuristically to capture all main aspects of the three models:

1. Using media and ICT to enhance educational processes: this category includes aspects relating to the pedagogical use of media in teaching and learning contexts. Hence, it is closely related to the German construct of *Mediendidaktik* and to the US discipline of educational technology.

2. Teaching about media/facilitating learners' media literacy: in this category, competencies are summarized referring to media educational tasks. These competencies are necessary for teachers to not only use media as a tool but also, e.g., to successfully foster reflective and responsible uses among their students. Hence, the category relates to the German concept of *Medienerziehung* and to the US concept of media literacy.

3. Teachers' own technological knowledge and ICT competencies: this knowledge and competency field summarizes all aspects necessary for a proficient use and handling of media and ICT in the sense of application and technical implementation, which is generally considered an important precondition for pedagogical media applications.

4. Media-related professional development: the competencies in this category refer to the context of professional development, i.e., of the continuing professional development and further education of teachers that can also benefit from targeted support by digital media, for example, in terms of continuing training, communication, or organization.

5. Media-related organizational development: this category addresses the competencies required in the field of organizational development in media-related contexts and is primarily targeted at the reformation and development of schools as the organizational frame for the teaching profession. The relevance of media in this field comes into play, e.g., in the implementation of efficient new media concepts for schools or in the improvement of organizational processes aided by ICT.

6. Content-related competencies: competencies with a reference to subject-specific domains, i.e., contents from school subjects, are summarized in this category.

7. Further generic professional teacher competencies: this broad category includes further aspects found in the models considered without a direct reference to media but with specification also for media-related contexts, such as competencies referring to learner orientation or assessment.

Notably, the definition of "further aspects without a direct reference to media" applies also to categories four to seven, because all of them describe competencies which also exist without a reference to media and ICT contexts. "Media-related professional development," for example, can be understood as a subset of general professional development competencies going beyond the media context. Yet categories four to seven were explicated due to their relevance for the models considered.

Taxonomies of the cognitive domain

For the classification of cognitive skills or competencies, it is an established practice in educational science to use Bloom's and Krathwohl's taxonomy (1956), or its updated version by Anderson and Krathwohl (2001; cf. Wilson 2016, regarding the differences and developments between the two versions). Considering the use of the terms *skills*, *competences/competencies* and *knowledge*, which vary among models, as pointed out above, *cognitive skills* in this context are understood quite broadly as one domain of human learning as opposed to affective or psychomotor skills. This renders the taxonomy applicable also for models referring to knowledge domains.

Bloom and Krathwohl (1956) define the six levels of cognitive skills, in order of increasing complexity, as 1) Knowledge, 2) Comprehension, 3) Application, 4) Analysis, 5) Synthesis, and 6) Evaluation. According to Anderson and Krathwohl (2001), they are 1) Remembering, 2) Understanding, 3) Applying, 4) Analyzing, 5) Evaluating, and 6) Creating.

Overall, the aspects introduced in this chapter illustrate different perspectives applicable to an in-depth analysis of competency models, and they show how models can be compared and assessed on different levels. A respective application will be introduced in the following chapter.

5.2   Category-based Model Comparison

Based on the analysis categories introduced above, it is now possible to apply the different viewpoints to the three models selected for an in-depth comparison (cf. Chapter 5.1.2). Consequently, the following chapter will introduce a criterion-based international comparative analysis of the three models DigCompEdu, TPACK and M³K.

5.2.1   Background

Date of publication

DigCompEdu was published in December 2017 (Redecker 2017) and M³K was developed in 2013 (Herzig et al. 2015). Koehler and Mishra officially introduced the concept of TPACK in 2005 and 2006 (Koehler and Mishra 2005; Mishra and Koehler 2006). These data allow for two conclusions: first, TPACK appears as the longest-established framework and DigCompEdu is comparably new. Second, the chronology suggests possible references between the models: M³K could build on TPACK while DigCompEdu could rely on both models as a source. It has to be investigated in the following to what degree the differing model age is relevant for the impact of the models, and if the potential cross-references do actually apply.

Authorship

DigCompEdu was developed by a team from the Joint Research Centre [JRC] led by Christine Redecker and edited by Yves Punie as the Deputy Head of Unit of the JRC Unit Human Capital and Employment. The JRC is the European Commission's science and knowledge service supporting EU policies with independent scientific evidence. It is based in Brussels with research sites in Belgium, Italy, Germany, the Netherlands, and Spain, and its work is largely funded by the EU's budget for Research and Innovation (Joint Research Centre [JRC] n.d.). TPACK, on the other hand, originates from a university context. It was published by Punya Mishra and Matthew J. Koehler, who are two researchers and teacher educators from Michigan State University in Michigan, USA. No external funding was involved in the original drafting of the model (Mishra and Koehler 2006). M³K also stems from an academic context. It was developed in a three-year German research project running from 2013 to 2015 and conducted by four university partners – the Universities of Würzburg and Bremen and two teams from the University of Paderborn – and a research institution, the German Leibniz-Institut für Bildungsforschung und Bildungsinformation [Leibniz Institute for Research and Information in Education; DIPF]. The M³K project was funded by the German Federal Ministry of Education and Research [BMBF] in the funding line "Competency modeling and competency measurement in the higher education sector" (KoKoHS; Humbold-Universität zu Berlin and Johannes Gutenberg-Universität Mainz 2019; Zlatkin-Troitschanskaia et al. 2017).

These authorships have implications in terms of sources and reference frames and in terms of stakeholder interests. The authorship and funding of DigCompEdu clearly point to an international orientation, and the EU funding implies an intended relevance of the model for international applicability. With regards to the M³K model, the national German research team and federal funding render a more national focus of the model likely. As in the case of DigCompEdu, the political stakeholder interest in this project can be expected to shape direction and outcomes. The project context creates framework conditions for a systematic and research-based model genesis process. TPACK also stems from researchers of one shared national background, but there is no direct political influence discernible in the development process. It will be revealing to explore in the following analysis how much these national or international frames have an impact on the focus. Hence, to substantiate findings from authorship, it is helpful to have a closer look at evidence from the models and related publications with regards to the reference framework.

National vs. international orientation

DigCompEdu was published in English and is intended for an international application all over Europe and beyond (Redecker 2017). TPACK has a primarily national reference frame, as it was originally targeted at US teacher education and written in English (Mishra and Koehler 2006), although it was operationalized for measurements in other national contexts as well later on (e.g., Endberg 2018; Sang et al. 2016). The M³K model has been developed in German, and it explicitly refers to German initial teacher education (Herzig et al. 2015). These observations substantiate the conclusion that M³K and TPACK are primarily focused on their national backgrounds, while DigCompEdu has a wider background in terms of political and international relevance.

Target group

DigCompEdu has European inservice educators as a target audience (Redecker 2017). TPACK was originally developed to describe the competencies of US elementary school preservice teachers (Mishra and Koehler 2006), even though various applications and developments of the model specified or extended this target group (e.g., Niess et al. 2009; Jordan 2011). M³K is explicitly targeted at German preservice teachers in the first phase of German teacher education taking place at universities (Herzig et al. 2015; Tiede and Grafe 2016).

Given the shared characteristics and differences between the German and US systems of teacher education (cf. Chapter 3.2.2), it will be revealing to look at the influences these national framings can have on the model contents. It can be hypothesized that the different focus on preservice teachers (M³K, TPACK) versus inservice teachers (DigCompEdu) will have a differentiating impact on the contents included in the models.

Main objectives and functions

The main objectives of DigCompEdu are summarized as: a conclusion on, and summary of, existing literature; guiding policy across all levels; a template for the local development of concrete instruments; a discussion and exchange of best practice across borders; and a reference for validating local frameworks and tools (Joint Research Centre [JRC] 2017). The main objectives of TPACK are: guiding research and curriculum development; offering analytic tools for studying teacher knowledge and educational technology; helping in the design of pedagogical strategies; describing a goal of teacher education; and "contributing, at multiple levels, to theory, pedagogy, methodology, and practice" (Mishra and Koehler 2006, 1046). Similarly, the main objective of M³K is a contribution to the improvement of teacher education programs.

The model summarizes German literature in the field of media-related teacher competencies and is intended to serve as a basis for respective competency measuring, as well as giving a guideline and standards for their advancement in the course of teacher education (Grafe and Breiter 2014).

In terms of Tulodziecki's and Grafe's (2019) classification, all three models are primarily intended for the functions of curriculum development and orientation and are also applicable for other functions, such as the evaluation of teaching and learning processes. Against the background of the different premises introduced above, the overall project objectives are remarkably similar. As a conclusion of all facets considered in this chapter on model backgrounds so far, all three models are designed in favor of a theory-based systematic curriculum development. Yet there are differences between the models with regards to their publication, authorship, reference context and orientation and target group, showing that the three models follow different approaches to reach similar goals.

5.2.2   Model Genesis

A comprehensive desk research was performed at the beginning of the work on Dig-CompEdu, focusing on existing national and international frameworks in Europe, initiatives, standards, etc. Research literature and expert consultations were included too, with a focus on frameworks from current practice (Joint Research Centre [JRC] 2017). From this research, the following sources were selected to serve as a basis for the new framework: 4 European initiatives, 11 national and 4 international frameworks/standards, 7 national self-assessment tools, 4 International and national course and certification schemes, and three pieces of research literature and expert opinions (*ibid.*, p. 47–54). The selected sources were then analyzed, and their distinct elements were mapped and clustered. This way, a first framework was drafted and validated, first by back-casting the competences onto the original frameworks and then by a three-step stakeholder consultation process that included teacher and expert workshops and expert opinions (Redecker 2017). This procedure follows the principles of an *a priori* or deductive research approach, including content validation.

The TPACK model genesis is primarily based on experiences made by the authors in the course of their university teaching and has been explained to amend Shulman's (1986) theory of Pedagogical Content Knowledge (M. J. Koehler et al. 2004; M. J. Koehler and Mishra 2005; Mishra and Koehler 2005; 2006; 2007; M. J. Koehler, Mishra, and Yahya 2007; Mishra, Peruski, and Koehler 2007; cf. Abbitt 2011). Hence, the development process combines characteristics of an *a priori* approach, due to the foundation in Shulman's (1986) work, with facets of a *post hoc* or inductive approach, due to the conclusions drawn from practice retrospectively. Yet, references

to other theories have also been pointed out: e.g., Pierson (2001) earlier explained the concept of technological pedagogical content knowledge, and other researchers used similar terms and concepts at about the same time (e.g., Angeli and Valanides 2005; Niess 2005). The TPACK model was validated in various studies by content validation and construct validation (for an overview of TPACK-related studies, cf. Voogt et al. 2012; Chai, Koh, and Tsai 2013).

For M³K, a broad literature review was performed at the beginning, focusing on national German research literature (e.g., Tulodziecki, Herzig, and Grafe 2010; Tulodziecki 2012; Blömeke 2000; Gysbers 2008) and including selected examples of international sources such as TPACK. Against this background, the model was drafted and subsequently validated inductively-empirically by a content validation (Schaper 2009b). National and international experts in the fields of media pedagogy and teacher education (n = 10) were interviewed in a semi-structured and qualitative methodology following the critical incident technique (Butterfield et al. 2005; Flanagan 1954). The interviews were evaluated and found to support and validate the proposed model (Herzig et al. 2015). Hence, the model can be summarized to stem from an *a priori* or deductive research approach.

Overall, the model geneses of M³K and DigCompEdu show certain similarities, as they were designed *a priori*, i.e., deductively, and were based on existent sources. TPACK also builds on one established source but otherwise approaches the development process inductively, which makes it an example of a model genesis process that unites *a priori* and *post hoc* research methodology characteristics. In accordance with the requirement of validity in the model selection for this analysis, all three models were validated in the course of their genesis or afterward.

5.2.3 Model Reception and Ongoing Development

In accordance with its recentness, the scientific reception of DigCompEdu is still emerging, although numerous research works from different countries already refer to it (e.g., Kullaslahti, Ruhalathi, and Brauer 2019; T. Koehler, Igel, and Wollersheim 2018; Benali, Kaddouri, and Azzimani 2018; Blanchard et al. 2019). The TPACK model, however, was validated, tested and used exhaustively in multiple studies (for an overview of TPACK-related studies, cf. Voogt et al. 2012; Chai, Koh, and Tsai 2013). In the course of this validation and further works on TPACK, the model has been challenged for various reasons. For example, some studies had difficulties in reproducing the seven knowledge domains in exploratory factor analysis (EFA; Archambault and Barnett 2010; Lux, Bangert, and Whittier 2011), and some questioned the theoretical construct, e.g., as "neither well defined nor stable" (Brantley-Dias and Ertmer 2013, 108) or as relying on a "fuzzy" base, namely PCK (Archambault and Crippen 2009; cf. also Angeli and Valanides 2009; Cox and Graham 2009; Voogt et al. 2012). Thus,

receptions are heterogeneous, but the overall status of research has been found to largely confirm all seven factors of TPACK and to address the criticism of lacking construct validation (Chai, Koh, and Tsai 2016). On the whole, it is recognized as "one of the most well-received and widely researched theoretical frameworks for technology integration in the classrooms" (Koh, Chai, and Lee 2015, 459).

The M^{3}K model has been noticed primarily in the German research community so far, as e.g., in Goetz (2018), Goecke et al. (2018), or Endberg (2018). Tulodziecki (2017) synthesizes it with other related German sources to develop a curricular framework for studies in the field of media pedagogy.

The scope of scientific reception of the three models in the study is heterogeneous. The quickly increasing reception of DigCompEdu implies an increasing interest in, and impact of, this model. The reception of TPACK is already enormous and illustrates that this model is a reference for many contexts and sources. With regards to the primarily German background, the German language and non-finalized empirical validation, the accessibility and application of M^{3}K is currently mainly limited to national contexts, although publications have begun to introduce it also to an international audience (Tiede, Grafe, and Hobbs 2015; Tiede and Grafe 2016; 2019). Remaining in the German context, related publications are comparably scarce. It will be subject to the analysis of the following model aspects to consider reasons for the different perceptions of the three models and to contextualize the interplay of background, model genesis and contents.

5.2.4   Structure

Type of model and overall structure
DigCompEdu offers six main areas of digital competence. These areas are (1) Professional engagement, (2) Digital resources, (3) Teaching and learning, (4) Assessment, (5) Empowering learners, and (6) Facilitating learners' digital competence. Each of these areas comprises certain competency aspects, amounting to 22 in total. Some of the competency aspects are linked, as illustrated in Figure 1.
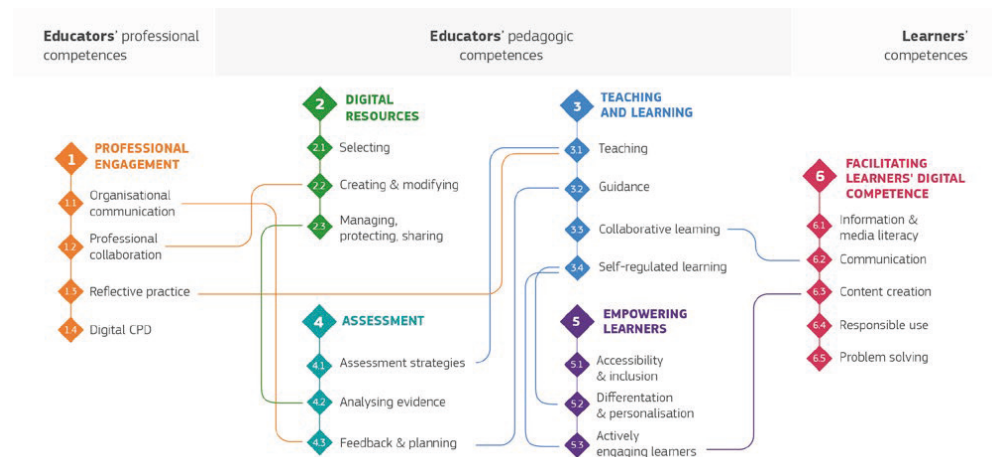
Fig. 1.: DigCompEdu Competency Model (Redecker, 2017, p. 8).

A central and distinctive feature of DigCompEdu is the proficiency scale included: each competence is described in six levels of progression, increasing from Newcomer and Explorer to Enthusiast and Professional, up to Expert and Pioneer, with according proficiency statements (Redecker 2017). The focus on the evaluation of learning success and on feedback and improvement makes DigCompEdu a competency development model. Hence, it answers the research desideratum of a systematic competency development model within the field of teacher education research expressed by Schaper (2009b). The levels are based on Bloom's and Krathwohl's taxonomy. In their terminology and design, they are linked to the Common European Framework of Reference for Languages (CEFR) taxonomy (Redecker 2017).

TPACK presents three dimensions of knowledge, namely Technological Knowledge, Pedagogical Knowledge, and Content Knowledge. These dimensions are arranged on one level without any sub-levels or categories, and their relationship and the overlaps originating from the interplay of these three dimensions are emphasized (Mishra and Koehler 2006; cf. Fig. 2). This makes TPACK a structural competency model in the sense of Klieme and Hartig (2007).
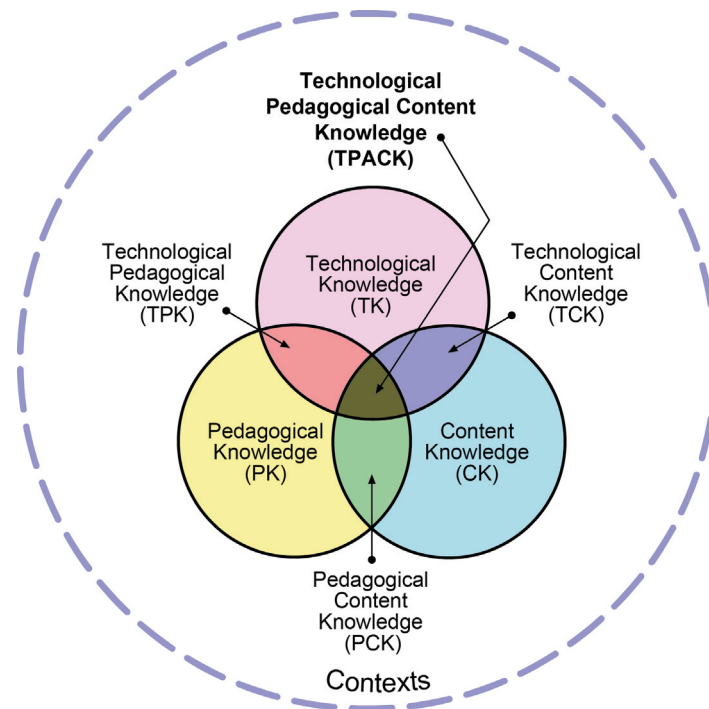
Fig. 2.: TPACK model (http://tpack.org).

M³K also defines three main dimensions, which can be described as "teaching with media," "teaching about media," and "media-related school reform." However, M³K also specifies competency aspects, and it is structured as a matrix, which explicates the interplay between competency fields and aspects. The matrix comprises the three mentioned competency dimensions at the upper axis and five competency aspects at the left axis. These competency aspects are (a) understanding and assessing conditions, (b) describing and evaluating theoretical approaches, (c) analyzing and evaluating examples, (d) developing one's one theory-based suggestions, and (e) implementing and evaluating theory-based examples. The fields that emerge are filled with standards of increasing complexity which are subject to a certain hierarchy based on Bloom's and Krathwohl's taxonomy (1956; Herzig et al. 2015). To sum up, M³K is a genuine structural competency model due to the focus on the interplay of dimensions, but with partly hierarchical and level-oriented standards suggesting a structural proximity to competency level models as well. Figure 3 shows the structural competency model in an overview, including non-cognitive facets, i.e., beliefs and perceived self-efficacy, and technical knowledge as further aspects with an influence on the shape and extent of *medienpädagogische Kompetenz* (Martin 2017).

Fig. 3.: M³K Structural competency model of Medienpädagogische Kompetenz (Diagram adapted from Herzig et al., 2016, p. 11).

To summarize the findings regarding the overall model structure, DigComp-Edu has been allocated to the group of competency development models; TPACK clearly is a structural competency model; and M³K has been interpreted to belong to this category as well even though it represents a more complex level-oriented approach in comparison to TPACK regarding the standards included. Yet it has been defined as a structural competency model because of the focus on the relationship between the competency fields and areas and because there are no competency levels quantifying the proficiency or degree of competency of a person. However, there are hierarchical structures within the M³K competency aspects and in the standard descriptions based on Bloom's taxonomy, which is a common feature for competency level models. Hence, M³K unites characteristics of both approaches. To conclude, this structural analysis of the three models confirms that the distinction between structural competency models and competency level or development models is not fully selective.

The allocation of the models either to the groups of structural competency models or to competency level or development models leads to questions about the level of details inherent in the model. Hence, the grain size of the models will be focused in the following.

Level of detail
DigCompEdu can be interpreted to represent the category of high level of detail. There are six competency areas with three to five competencies each, and a non-exhaustive list of examples is included to suggest activities that express the according competence without delimiting it. What sets this model apart is also the proficiency scaling, as described above, specifying levels of competency from Newcomer to Pioneer. In Neumann's (2013) terminology, this means a comparably small grain size of competency levels.

In the distinction between low, medium and high level of detail, TPACK fits into the category of low level of detail. The three main knowledge domains are presented

on one level and are equally interdependent, which means there is no hierarchy in their arrangement. Their intersections are labeled, but the model itself does not offer explanations, specifications or sub-categories of the domains. Also, there is no scale to differentiate levels of knowledge.

M³K can be understood to have a medium level of detail. There are three competency areas, and each of them comprises five competency aspects. Two to four standards specify these competency aspects with increasing complexity. Two to four sub-standards further specify some of these standards in greater detail. Overall, the five competency aspects and the standards increase in complexity: e.g., the verbs of the competency aspects range from "understanding and assessing" in the first aspect to "implementing and evaluating" in the fifth aspect (cf. Bloom and Krathwohl 1956). Thus, the M³K competencies follow a certain hierarchy and partly build on each other, unlike the TPACK structure where all competencies are on one level and equally interdependent. This is also true for the formulation of aspects, which are equally oriented towards Bloom's taxonomy. Yet M³K does not offer an elaborate proficiency scale for measuring competency levels in the way DigCompEdu does.

Notably, the distinction of levels of detail corresponds to the results of the structural analysis attributing a straight-forward structure to TPACK, a medium complex structure to M³K and a structure of comparably high complexity to DigCompEdu. These results feed into the overall impression of differing complexity of the three models, which had been evident at first sight but is now systematically clarified. While this conclusion is based on structural analyses, the level of content will be added in the next paragraphs.

5.2.5   Contents

Topic and terminology
On a general level, all of the models describe aspects that are considered important on the side of preservice and inservice teachers for technology-enhanced teaching, teaching in the context of media and other media-related educational processes. M³K and DigCompEdu focus on competencies, albeit with a different focus and terminology. In accordance with the context of preservice teacher education, M³K refers to the scientific basics of pedagogical media competencies that are or should be acquired in university teacher training and are necessary for coping with according situations in the teaching profession (Herzig et al. 2015). DigCompEdu, on the other hand, focuses on educator-specific digital competences that are required to effectively teach with digital tools and use digital tools for teaching (Redecker 2017). The TPACK framework does not describe competencies but knowledge domains of

technological pedagogical content knowledge of teachers and has been summarized as "the basis of good teaching with technology" (Mishra and Koehler 2006, 1029).

It is challenging to compare these different approaches on a terminological level. *Medienpädagogische Kompetenz* is obviously not congruent with *educators' digital competence* and clearly even less so with *technological pedagogical content knowledge*. Additionally, the relationship between "competence/competency" and "knowledge" is an issue of concern, as argued in Chapter 2. In a narrow sense, and following the competency definition of Sampson and Fytros (2008) where knowledge is understood as a subset or constituent of competence or competency, it could be assumed that technological pedagogical content knowledge is merely a constituent of *medienpädagogische Kompetenz* or educators' digital competence and not a comparable model. However, it was explained in Chapter 3 that these terms are strongly tied to their cultural, national and language background and not directly comparable. Hence, comparative conclusions need to focus on competency aspects, areas and fields to achieve a valid comparative perspective, instead of comparing terms especially in the context of different source languages.

Aspects, areas and fields

To contextualize the contents of the three models, it is useful to approach their competency aspects by means of superordinate categories in order to maintain an independent viewpoint and to follow the idea of a *tertium comparationis*. Hence, the following categories were derived inductively, i.e., based on findings from the models, to help summarize and categorize all main aspects of the three models: 1) Using media and ICT to enhance educational processes, 2) Teaching about media/facilitating learners' media literacy, 3) Teachers' own technological knowledge and ICT competencies, 4) Media-related professional development, 5) Media-related organizational development, 6) Content-related competencies, and 7) Further aspects without a direct reference to media.

1. Using media and ICT to enhance educational processes: in DigCompEdu, there are respective references particularly to the fields of "Digital Resources," "Digital Pedagogy," and "Digital Assessment," e.g., in "Assessment strategies: To use digital technologies for formative and summative assessment" (Redecker 2017, 21). In TPACK, the knowledge required for applying ICT in a pedagogically sound way is referred to as "technological pedagogical knowledge" (TPK):

   this might include an understanding that a range of tools exists for a particular task, the ability to choose a tool based on its fitness, strategies for using the tool's affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies. (Mishra and Koehler 2006, 1028)

This aspect is also important in M³K and represented in the main competency area of *Mediendidaktik* (teaching with media), as for example, in the competency standard claiming "preservice teachers are able to are able to analyse media education activities considering different components of the theory-based development of teaching and learning processes and to evaluate these with regard to their appropriateness for a planned lesson" (Herzig et al. 2016, 14; own translation).

2. Teaching about media/facilitating learners' media literacy: respective competencies are represented in DigCompEdu especially in the field of "Facilitating Learners' Digital Competence." For example, this field contains the aspect "responsible use," which also means "to empower learners to manage risks and use digital technologies safely and responsibly" (Redecker 2017, 25). TPACK does not mention an according reference explicitly. From a systematic viewpoint, respective references would belong to the interplay of technology and pedagogy, i.e., into the field of technological pedagogical knowledge (TPK), because teaching about media and facilitating learners' media literacy requires knowledge aspects from both of these fields but is not connected to content knowledge. The description for TPK offered by Mishra and Koehler (2006), however, focuses on the application of media and ICT to enhance teaching and learning processes solely. M³K, on the contrary, describes competencies in *Medienerziehung*/teaching about media as one out of three central competency areas. It refers, e.g., to teaching students to reflect on media critically and to understand conditions of media production, or to fostering responsible online behavior.

3. Teachers' own technological knowledge and ICT competencies: both DigCompEdu and TPACK refer to skills that are needed to operate and apply ICT in lessons effectively. DigCompEdu shows references mainly with regards to the operation of digital media, as in "managing, protecting and sharing digital resources" in the field of "digital resources," which means also "to effectively protect sensitive digital content. To respect and correctly apply privacy and copyright rules" (Redecker 2017, 24). It should be noted, though, that most of the references to educators' own technological knowledge are closely linked to and concretized for educational contexts and purposes, as for example, in "analyzing evidence": "to generate, select, critically analyse and interpret digital evidence on learner activity, performance and progress, in order to inform teaching and learning" (*ibid*., p. 25). Such concretizations suggest the assignment of the respective competency aspects also to category one in a majority of cases. For TPACK, technological knowledge is "knowledge about standard technologies, such as books, chalk and blackboard, and more advanced technologies, such as the Internet and digital video. This involves the skills required to operate particular technologies" (Mishra and Koehler 2006, 1027). This emphasis on the actual operation and use of technologies is

noteworthy because this is the only skill in TPACK that goes beyond the domain of mere knowledge and addresses operation and application skills. In contrast to that, M³K explicitly excludes the area of technological knowledge from media pedagogical competencies and describes it as a correlate, which has an influence on the shape of *medienpädagogische Kompetenz* but does not constitute it (Herzig et al. 2015).

4. Media-related professional development: DigCompEdu shows references to this category in the field of "Professional engagement," especially with regards to "reflective practice," which means "to individually and collectively reflect on, critically assess and actively develop one's own digital pedagogical practice and that of one's educational community" (Redecker 2017, 24), and to "digital continuous professional development." TPACK does not indicate a corresponding aspect, although the authors acknowledge a need for professional and faculty development to ensure the acquisition of respective TPACK knowledge in the related publication (Mishra and Koehler 2006). Likewise, the M³K model does not include a specific reference.

5. Media-related organizational development: in DigCompEdu, competencies referring to media-related organizational development are also included in the field of "professional development," as for example, with regards to "organizational communication": "to contribute to collaboratively developing and improving organizational communication strategies" (Redecker 2017, 24). TPACK shows no explicit reference to media-related organizational development. M³K, however, lists *medienbezogene Schulentwicklung* [media-related school development] as the third main competency area beside media didactics and media education. It describes "the ability to co-design school reform development processes in the field of media, e.g., by assessing and designing staff, infrastructural, legal or organizational conditions for media pedagogical measures and their realization at school" (Herzig et al. 2015, 156; own translation).

6. Content-related competencies: in DigCompEdu, the notion of competencies with a reference to content or content knowledge comes into play in the descriptions of some aspects such as "digital continuous professional development," which also means "to use the internet to update one's subject-specific competences" (Redecker 2017, 40), or in "assessment strategies": "to use digital technologies to enhance summative assessment in tests […], using simulations or subject-specific digital technologies as test environments" (*ibid*., p. 62). Thus, respective competencies and knowledge are inherent in the idea of a fully developed digital competence, according to DigCompEdu, but do not directly shape a specific competency aspect or field. For TPACK, on the other hand, content is at the core of the model, constituting the domains of Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK) and, most

centrally, Technological Pedagogical Content Knowledge (TPCK). It is a substantial characteristic of the TPACK model that content as one of the three main basic knowledge domains is closely connected with pedagogical knowledge and technological knowledge for any integration of technology into teaching and learning processes: "our model of technology integration in teaching and learning argues that developing good content requires a thoughtful interweaving of all three key sources of knowledge: technology, pedagogy, and content" (Mishra and Koehler 2006, 1029). Finally, M³K does not describe content knowledge by a distinct field or aspect. However, the notion of necessary content knowledge is inherent in a number of aspects that relate to developing, testing and evaluating media pedagogical actions, such as in the field of "developing own suggestions for media pedagogical actions based on theory": "preservice teachers are able to outline examples of lessons or projects with media use with regards to teaching actions and learning activities, including contents, social formats and media […]" (Herzig et al. 2016, 15). It is obviously necessary to have a certain content knowledge at one's disposal in order to be able to outline a concept for a media-enhanced lesson. Yet content knowledge does not directly constitute *medienpädagogische Kompetenz* in the sense of the M³K model and can thus be understood to be a correlate, similarly to the role that technological knowledge plays in this regard.

7. Further generic professional teacher competencies: in DigCompEdu, a number of further competencies are addressed which are unique across the three models in the sample. These aspects can be characterized as constituents of general pedagogical professional competencies with a specification to media contexts. Some of these competencies are unique because they represent a high level of detail; this is the case, e.g., in the field of assessment describing digitally supported assessment strategies. Assessment is not explicitly mentioned either in TPACK or in M³K, but this may be connected to the fact that the descriptions in these two models are rather open compared to DigCompEdu: digitally enhanced assessment can be part of the wide range of knowledge aspects included in technological pedagogical knowledge, and it also relates to the idea of developing, testing and evaluating media-enhanced lessons or projects in classes as suggested by M³K. Similarly, further unique DigCompEdu competencies include those mentioned in the field of "empowering learners," such as "actively engaging learners." Also in this case, there is a specification of a generic pedagogical professional competence for a media-related context, and this, too, goes beyond the level of detail represented in TPACK and M³K.

This category-based overview of model contents reveals that there are peculiarities with all three models, each of them representing a unique focus. The field of "using media and ICT to enhance teaching and learning processes" is the only overlap

shared by all three models and thus represents a linking dimension. With regards to the facilitation of learners' media literacy, the TPACK model stands out due to the explicit focus on the educational use of media at the expense of media literacy aspects. Against the background of the disciplinary distinction between educational technology and media literacy common in the USA (cf. Chapter 4.2), the TPACK model is clearly advocating the educational technology perspective and thus employs a strict focus, whereas the European DigCompEdu model and the German M³K model consider and include both educational technology and media literacy perspectives as two central constituents of one interconnected construct of competence.

With regards to technological knowledge and ICT competencies, M³K takes on a special position. Technological knowledge is not considered a core constituent of pedagogical media competencies but a correlate and impactful variable, because it is understood as a responsibility of schools to provide students with basic technological knowledge and media literacy. Hence, preservice teachers should start their university education with a background of according knowledge, which then needs to be consolidated but not newly acquired (Tulodziecki, Herzig, and Grafe 2019; Herzig et al. 2015). Against the background of this assumption, it is consistent not to include technological knowledge in a model that intends to describe the competencies that should be acquired in university teacher education. DigCompEdu links to this perspective insofar as mere technological knowledge and application competencies are not a key competency within the concept of educators' digital competence. As argued above, references are included but mostly connected to educational usages, which corresponds to the concept of *Mediendidaktik* in M³K. In TPACK however, technological knowledge (TK) is a core constituent of the model and thus receives a different status compared to M³K and DigCompEdu.

The different notions of media-related professional development represented in the three models can be interpreted to be linked to the original target group of the models. Professional development is an important task for inservice educators, which helps explain why this aspect is important in the DigCompEdu model for inservice educators but is not explicitly mentioned either in TPACK or in M³K, both of which were designed in the context of initial teacher education. Media-related organizational development is, however, a key competency area in DigCompEdu and in M³K, and it emphasizes the different focus assumed by TPACK. Against this background, the conclusion is substantiated that the perspective postulated in the TPACK model is narrower than those represented by DigCompEdu and M³K, as it focuses on the educational implementation of technology only and consequently excludes further facets of teaching and learning and educational processes in media-related contexts.

As argued above, the three models also illustrate different approaches to the field of content knowledge, with TPACK emphasizing content as a core constituent of the model and DigCompEdu and M³K implicating respective facets primarily in application contexts. Given the prior conclusion of a narrow focus of TPACK on the educational implementation of technology, the very close view on educational media-enhanced teaching and learning processes goes in line with this explicit inclusion of content knowledge. This would be less suitable for the inclusive and one-dimensional structure of the TPACK model if other perspectives, e.g., on professional development or further media-related tasks, were part of the model as well. On the micro-level of teaching processes, however, the emphasis on content knowledge works well and appears consistent. Furthermore, this focus is congruent with the perspectives postulated in further sources from the US emphasizing the infusion of technology into content curricula instead of separating educational technology classes (Foulger et al. 2017 cf. Chapter 9.2).

In terms of further generic professional teacher competencies, the comparison revealed that the model elements which set apart DigCompEdu from the other two are to be found primarily in the area of "empowering learners." As this framework was drafted deductively against the background of numerous other sources (Joint Research Centre [JRC] 2017), it is interesting to observe that there are yet considerable competencies which do not play an explicit role in TPACK or in M³K, although a facet like "empowering learners" may be inherent in the broad and universal description of pedagogical knowledge in TPACK:

> "Pedagogical knowledge (PK) […] is a generic form of knowledge that is involved in all issues of student learning, classroom management, […] and student evaluation. It includes knowledge about techniques or methods to be used in the classroom; the nature of the target audience; and strategies for evaluating student understanding. A teacher with deep pedagogical knowledge understands how students construct knowledge, acquire skills, and develop habits of mind and positive dispositions toward learning. As such, pedagogical knowledge requires an understanding of cognitive, social, and developmental theories of learning and how they apply to students in their classroom." (Mishra and Koehler 2006, 1026–27)

All in all, DigCompEdu has been described to include a number of unique competency facets which are based on the level of detail assumed by the DigCompEdu model in terms of contents which differs from the rather broad competency aspects in M³K and especially from the considerably vague and non-specific knowledge domains in TPACK. Overall, it is noteworthy that the differences between the three models mentioned earlier in the context of the structural level of detail are replicated also with regards to the contents. The DigCompEdu model defines its competency aspects in

quite a detailed way. Compared to M³K and even more to TPACK, this makes the model very specific and presumably easy to apply because no further concretions are necessary.

5.2.6   Theoretical versus Practical Orientation

An aspect that sets apart DigCompEdu is its emphasis on skills of application of digital media in all stages, ranging from the assessment and selection of digital resources to a meaningful and successful use for a variety of purposes and its evaluation. Opposed to that, TPACK is focused primarily on theoretical knowledge and includes implementation mainly in the field of technological knowledge, as described above. In the case of M³K, three out of five competency aspects applying in the three main fields of *medienpädagogische Kompetenz* describe theory-focused competencies: the verbs are "understand" and "evaluate" in the first aspect, "characterize and evaluate" in the second aspect and "analyze and evaluate" in the third aspect. The fourth aspect merges theoretical and practical foci: "develop based on theory," and the fifth aspect has a practical focus with "try out and evaluate" (Herzig et al. 2016). Hence, the M³K model unites theoretical and practical foci with a certain emphasis on theoretical facets. This emphasis needs to be seen against the background of the two phases within the German system of teacher education. The M³K model explicitly refers to German university teacher education, which is a unique system in the international context. While other systems sometimes merge the theoretical or academic and practical education of preservice teachers, the German system of teacher education is structured in two phases (for an overview of the German teacher education system, cf. Blömeke 2009; Kotthoff and Terhart 2013). In the first phase, preservice teachers are primarily educated at universities and acquire reflexive scientific competences based on scientific foundations and theory-based instructional knowledge, with the academic studies being enhanced by school placements (Van Bargen 2014). These basics are connected to, and amended by, practical skills and procedural knowledge in the second phase of German teacher education, where, after about 5 years of studying at universities, preservice teachers are placed in schools and start their teaching career with support of seminars and other teachers, until their education is finished – approximately one and a half year to two years later. In this context, M³K focuses on the description of cognitive competencies that preservice teachers should acquire in the course of this scientific education at universities, with practical competencies included applying in scenarios where preservice teachers can test and evaluate media pedagogical actions.

To substantiate this observation, it is helpful to classify the competencies, e.g., by Bloom's and Krathwohl's taxonomy (1956), or its updated and improved version by Anderson and Krathwohl (2001). Based on Bloom and Krathwohl (1956), Anderson

and Krathwohl (2001) define the six levels of cognitive skills, in order of increasing complexity, as 1) Remembering, 2) Understanding, 3) Applying, 4) Analyzing, 5) Evaluating, and 6) Creating.

DigCompEdu has a strong focus on the level of "Applying." Although some references to all other levels of cognitive skills can also be discovered, except for "Remembering," most of the competence descriptors are concerned with application skills, as in "Actively engaging learners":

> "To use digital technologies within pedagogic strategies that foster learners' transversal skills, deep thinking and creative expression. To open up learning to new, real-world contexts, which involve learners themselves in hands-on activities, scientific investigation or complex problem solving, or in other ways increase learners' active involvement in complex subject matters." (Redecker 2017, 74)

While single classifications might be disputable or ambiguous, the taxonomies indicate varying tendencies of the three models in question. They help to illustrate and ground the impression that the foci of the three models differ, because TPACK is mostly about declarative knowledge, M³K emphasizes cognitive competencies from understanding to evaluation, and DigCompEdu focuses on practical skills, i.e., skills of application.

As mentioned before, TPACK is concerned with knowledge. The model itself does not indicate verbs that could help draw inferences on cognitive skills, but the authors' explanations of the domains of TPACK do (Mishra and Koehler 2006). Remarkably, the authors describe in detail the different knowledge aspects that preservice teachers need to be familiar with and understand, and the verbs are mostly limited to "know" and "understand." For example, in the case of Pedagogical Knowledge (PK), it says: "A teacher with deep pedagogical knowledge understands how students construct knowledge, acquire skills, and develop habits of mind and positive dispositions toward learning" (*ibid*., p. 1027). However, in the case of Technological Knowledge (TK), the knowledge-focused explanations are blurred with the more complex cognitive skill of "applying," as in the following sentence: "In the case of digital technologies, this includes [...] the ability to use standard sets of software tools such as word processors, spreadsheets, browsers, and e-mail" (*ibid*.). Apart from this divergence, the relevant levels of cognitive skills in TPACK are "Remembering" and "Understanding."

For M³K, it makes sense to consider the standards for an investigation of cognitive skills in addition to the competency aspects analyzed for their verbs above, as they operationalize the competencies. These verbs indicate that all levels of cognitive skills are addressed to varying degrees, with a remarkable emphasis on "Evaluating," as for example, in standard A5.2: "The preservice teachers are able to assess, interpret and reflect upon collected data with regard to issues of teaching and learning with media" (Herzig et al. 2016, 16).

The focus on the reflexive and analytic competencies of the German M³K model is a distinctive feature which is not equally represented explicitly either in TPACK or in DigCompEdu. Van Ackeren et al. (2019) explain this focus on analysis and reflection within German research with a unique understanding of the concept of *Bildung*, which distinguishes the German perspective by targeting a reflexive relationship to the world, to social peers and to oneself. Naturally, this explanation offers only one perspective on a complex range of factors influencing the contents and foci within a specific research community.

In this context, TPACK is also mostly restricted to knowledge basics and is less about implementation. This is consistent because TPACK also comes from a university background, was developed in the context of teacher education and postulates an explicit focus on knowledge domains instead of competencies, as in the cases of DigCompEdu and M³K. Hence, both M³K and TPACK show fewer references to practical skills of application. However, the focus in regard to these facets in the M³K and TPACK models for preservice teachers does not reduce the relevance of respective competencies for inservice teachers. M³K and TPACK, on the one hand, and DigCompEdu, on the other, complement each other because it is equally consistent to include these practical skills into the DigCompEdu framework of inservice educators' competencies.

5.3 Conclusion and Discussion of Comparison Results

The in-depth analysis and comparison of three models reveals a new perspective on the competencies in question. It has become obvious why there is no universal definition of media-related educational competencies nor a common understanding. The three models in the study prove that there are divergent ways of approaching and describing the competencies in question. They share some central ideas and concepts, e.g., on the importance of a pedagogical use of media, but their contexts and foci differ, as illustrated above.

The considerations show the value of exploring the origins of the models. Given that M³K is strongly tied to its national background, it will need further investigations to find out if it can be used in other contexts as well, and if results can be compared adequately (cf. Tiede and Grafe 2016; 2019). On the other hand, TPACK has also been successfully used, researched and validated in multiple national and international contexts. It has been pointed out that TPACK has a very high level of abstraction and a low level of detail, as opposed to the more concrete competency specifications in M³K and DigCompEdu. Despite, or maybe even because of this less specific and rather general nature of the model, TPACK has proven successful and received a lot of attention. It is well-established and has been impacting various succeeding research works. From a research perspective, the low level of detail has been criticized not

only in terms of its partly inductive approach but also with regards to measurement, because there are no precise competencies, skills or knowledge aspects that could be operationalized for testing; thus, there is an inherent danger of its lacking validity in the sense of item-construct fit (Angeli and Valanides 2009; Cox and Graham 2009). However, the other side of the coin is a broad applicability and an appealing model that is easy to understand and open to interpretation and concretion for all kinds of cases. In future works on, and improvement of, existing models and in the development of new models, this bias of appeal and usability, on the one hand, and concretion and situational fit, on the other, will be important to consider.

All in all, the focus of the models is different, but they still complement each other. Generally, it has been observed that there is a considerable variety of existent models, and now it becomes clear that such a variety of approaches is necessary with respect to the various backgrounds and uses of competency models, as different approaches serve different purposes and have to be chosen carefully.

The study presented introduced a systematic and grounded deductive approach to assessing and comparing competency models. For future studies, it will be desirable to reproduce and refine the procedure and to extend it to more contexts and models. Such a careful synthesis and comprehensive consideration will be an appropriate way to look beyond borders in the sense of Blömeke and Paine (2008), to overcome ethnocentricity (Phillips 2006), and thus to make grounded decisions which will facilitate a successful exploration of media-related educational competencies.

With regards to the first research question, "Which central models of media-related educational competencies are there in German and US research, and what are their shared characteristics and differences?", this first part provided an overview of competency models from different contexts. A range of important model characteristics, compliances and differences was introduced, and their functions were contextualized in the light of model backgrounds and purposes. The aspects considered necessarily represented an approach that can always be amended and extended in further studies; yet the perspective achieved is comprehensive and a useful basis to build on in the following considerations of measurements and practices of advancement, which will be subject of the next parts of this dissertation.

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