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

## Conclusions: Media-related Educational Competencies of German and US Preservice Teachers

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*In the previous three main parts, the dimensions of modeling, measuring and advancing media-related educational competencies were analyzed in detail. Against this background, it has now become evident how closely interrelated the three dimensions are. The fourth research question addresses this issue: “What is the relationship between modeling, measuring and advancing media-related educational competencies in both countries?” Hence, the following final chapter will bring together and draw conclusions on the findings presented above and conclude the work with an overall summary and analysis of the relationships between modeling, measuring and advancing media-related educational competencies and with an outlook to further perspectives and research desiderata.*

### 12. Conclusions on the Relationship of the Three Core Dimensions, and Outlook to Further Research Perspectives

#### 12.1 *The Relationship between Models, Measurements, and Practices of Advancement of Media-related Educational Competencies*

It was the fundamental aim of this dissertation to explore media-related educational competencies by providing a multi-perspective view on this complex topic. For this purpose, three main perspectives were focused, namely modeling, measuring and advancing competencies. Based on the findings for each of these three dimensions, it is now possible to summarize main outcomes and then analyze the links and relationships between models, measurements and practices of advancement.

Considering models of media-related educational competencies, Part I of this dissertation revealed the conceptual heterogeneity of media-related educational competencies and showed facets and aspects of models which can differ. It was explained that there are valid reasons for models to vary: competency models are always influenced by a network of criteria that contribute to the individual design of each model. The differentiating criteria identified and analyzed in Part I with three models as examples from an international context, the USA, and Germany are summarized in detail in Table 17.

Analysis category	Aspects
Background	Date of publication
	Authorship
	National vs. international orientation
	Target groups
	Main objectives/functions
Model genesis	<i>A priori</i> or <i>post hoc</i>
	Inductive or deductive
	Validation
Structure	Structural competency model, competency level model, or competency development model
Level of detail	Number of sub-competencies
	Grain size
Contents	Topic and terminology
	Competency aspects, areas and fields
	Taxonomies of the cognitive domain

**Tab. 17.:** Distinctive model characteristics identified.

This list systemizes how models can differ from each other strongly even if sharing central aspects. For example, it has been argued that the M<sup>3</sup>K model and the DigCompEdu model are both models developed by an *a priori* approach that aim to describe media-related educational competencies needed to cope with various media-related tasks in teaching and learning scenarios. Yet there are differences between the two models – e.g., with regards to background, target group, grain size, and contents – that account for the different shapes and applicability of the two, despite their parallels. All in all, the models analyzed led to the impression that German research on media pedagogy has a solid tradition of competency research and of respective modeling approaches which are often developed either by single researchers or in project contexts. In the USA, guidelines and standards drafted in professional societies were discovered to amend competency models developed in university settings, as for example, the ISTE standards or the NAMLE Core Principles of Media Literacy Education, which are widely influential.

With regards to measurements, it was explained in Part II that competency measurements are beneficial for tracking the performance of competencies in practice and that there are three angles to consider: competence as a construct, the observation of performance evoked by tasks, and the interpretation of the data collected. The design process of tasks and items should always take into account the respective application context and function of the measurement. Differentiating factors identified in the context of item design were: objective or subjective responses, standardization of items, and their quantitative or qualitative orientation. For the interpretation

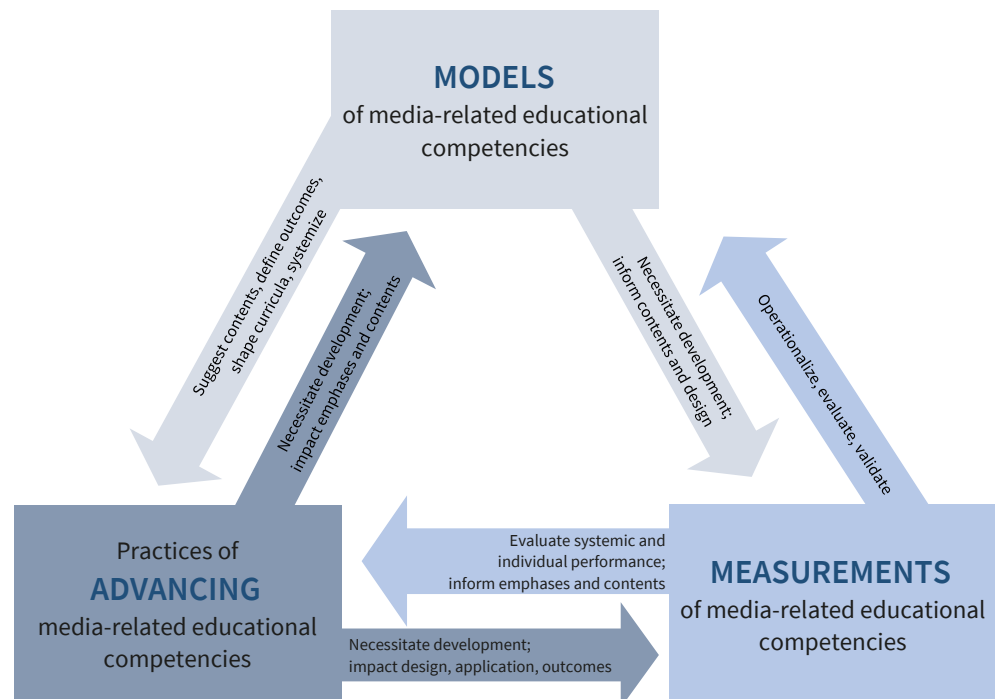
of data, again, differences with regards to the purpose of the measurement apply, as in terms of the criteria against which tests can be evaluated, i.e., social or individual reference frames or criterion-based assessments. The multifold functions of measurements described in Part II can be summarized as evaluations at the individual and systemic levels and the validation of competency models. In the context of an example of a measurement of media-related educational competencies of German and US preservice teachers, the importance of cultural adoptions was pointed out, and the necessity to align the instrument with context and function was illustrated.

Based on a literature review and on interviews with German and US experts, Part III revealed considerable heterogeneity in the field of current practices in initial teacher education. Such practices were identified to depend on stakeholders on different levels. Societal context and policies especially on national and state level define the macro level; institutions, i.e., professional organizations and institutions of higher education make up the meso level; and the overall research and practice background and actors constitute the micro level. There are interdependencies and mutual influences between all of these interest groups regarding the practices of advancing media-related educational competencies in initial teacher education in Germany and the USA.

Most of the findings in relation to stakeholders were found to apply to both countries, albeit with different foci and emphases in some cases. With regards to universities, for example, it was described that German preservice teachers themselves tend to have a greater influence on their own media-related education compared to their US peers. In terms of the actual implementation of respective contents into teacher education, the literature review revealed an increasing awareness of the necessity to integrate media in both countries. In Germany, the degree to which media-related contents are obligatorily integrated into initial teacher education was described as heterogeneous and as differing from state to state. At some places, such obligatory offerings are also amended by respective electives. All in all, the situation is characterized as deficient in a majority of related German sources. In the US, educational technology is comparably widespread across formal teacher education curricula, and media literacy has been found to increase in significance as well. There are fewer chances for electives and curricula that are mostly prescribed by the institutions of teacher education. Yet researchers in related sources are repeatedly pointing out unsatisfactory outcomes in terms of teachers' media-related educational competencies. The technology infusion approach is a rather recent US contribution to improving practices in initial teacher education. It suggests replacing educational technology courses with an integration of technology across all other subjects, an idea which is partly echoed in recent German sources as well.

Against the background of these main findings, it becomes obvious that the three main dimensions of modeling, measuring and advancing media-related educational

competencies are closely linked to each other. Figure 8 summarizes and illustrates these links in favor of a systematic exploration. It abstracts the findings made in the comparative analysis of models of media-related educational competencies – introduced by a broader overview of models from international contexts, the USA and Germany, and explicated with the examples of DigCompEdu, TPACK and M<sup>3</sup>K –; in the analysis of measurements of media-related educational competencies in both countries; and with regard to practices of advancing media-related educational competencies in German and US systems of initial teacher education. Consequentially, the links between the three main dimensions depicted in Figure 8 summarize these main findings that are applicable in both the US and the German context. They abstract general conclusions on the relationships as identified by the international comparative methodology applied. These links between the three illustrated dimensions will be explicated in the following.



**Fig. 8.:** Model of relationships between three dimensions of modeling, measuring and advancing media-related educational competencies.

### 12.1.1 Models and Measurements of Media-Related Educational Competencies

Generally, it has become evident that modeling and measuring media-related educational competencies are two closely connected processes. Based on deductively or inductively oriented research approaches, models aim to summarize, define and

specify central competencies in a specific context. However, identifying competence in practice based on models remains problematic, as competence is a construct that is by definition non-observable. Moreover, analysis of selected models, especially from the US context, showed that models vary strongly with regards to their level of detail and specificity. TPACK was introduced as an example of a model with a low level of detail. This characteristic makes it widely useable and applicable for a variety of contexts but poses challenges in terms of defining what the competencies or, in the case of TPACK, knowledge domains comprise exactly. Hence, models necessitate the development of measurement instruments to address the challenges connected to the non-observability of competencies and to explore performance from which the presence and proficiency level of a competence can be derived. To this extent, models inform the contents and design of measurement instruments and offer systematic orientation and thematic guidance for measurement approaches.

On this basis, measurement instruments are then designed to operationalize the model contents by concretizing them to measurable performance indicators. Thus, they are a helpful means for approaching, exploring and visualizing the occurrence of the competency in question by help of performance. It was illustrated in Part II that this process of operationalizing model contents can look quite different in some cases, depending on the purpose of the measurement and on the characteristics of the competency model. The M<sup>3</sup>K model, as an example of a German model of *Medienpädagogische Kompetenz*, included standards which could then be transformed into scenarios for simulating real-life situations as a background for participants to make grounded choices. This measurement approach was designed to realize the claims made by the model to offer a contribution to the improvement of German initial teacher education; consequently, the measurement instrument was designed to be applicable for larger audiences and thus eventually suitable for the evaluation of systemic processes. To this extent, the M<sup>3</sup>K measurement instrument transfers outcomes of German competency model research to practice and therefore builds a link from the dimension of modeling to the dimension of practice. Regarding research in the US, the example of TPACK showed that there are various ways of applying a model in practice by means of an instrument. The lower level of detail in TPACK resulted in significant differences between different measurement instruments.

The relationship between models and measurements of media-related educational competencies is obviously not unidirectional. As argued in Part II, measurements can also impact competency models. Particularly with regard to the validation of models, measurement instruments play an important role by contributing to the analysis of model validity. Suitable statistical analyses of respective data collections offer valuable conclusions for the ongoing development of models, and models that have not been validated by measurements of any kind remain exploratory and of limited informative value, given their questionable validity. In this context, the case

of the non-finalized validation of the M<sup>3</sup>K instrument illustrates again the role measurements can play as a link between models and practices of competency advancement. Though the model design was built on respective literature, it was argued that missing learning opportunities in initial teacher education are assumed to have contributed to a data analysis and model validation that was not satisfactory in all aspects. Thus, the measurement helped visualize a gap between theoretical claim (i.e., model) and practice.

Comparable results can be pointed out with regard to the US context. Also in the case of TPACK, measurements were used to confirm and validate the structure and contents of the model. As argued above, such approaches led to criticism about the validity of the model (e.g., Archambault and Barnett 2010; Lux, Bangert, and Whittier 2011) and thus contributed to the ongoing scientific discourse, reception and research of the basic model.

While the examples from Germany and the USA are necessarily selective and representative of their respective national research context to a limited extent only, they yet substantiate the conclusion that the relationship between models and measurements of media-related educational competencies in both countries is to a large extent comparable. The mutual influences of the described models and measurements apply in both cases and thus support the summarization in Figure 8.

#### *12.1.2 Measurements and Practices of Advancement of Media-Related Educational Competencies*

Besides its influence on models, the dimension of measurement also informs practices of advancing media-related educational competencies. It offers insight into the effects and outcomes of practices on an individual level, especially with regards to preservice teachers, and on a systemic level, particularly in the context of measurement application in a certain cohort. In this way, measurements contribute to the evaluation of educational processes.

Consequently, as became evident in the expert interviews (cf. Part III), current practices both in Germany and the USA are increasingly geared towards standardized and assessable outcomes and measurable results. As a result, stakeholders are well-advised to derive content for initial teacher education curricula from relevant instruments and to ensure that preservice teachers receive targeted preparation for the accomplishment of important assessments as a focus of their efforts in competency advancement. This is why it appears justified to claim an influence of measurement instruments on emphases and contents in teacher education practices. The criticism expressed by some experts towards this development is substantiated by the role of measurements illustrated here: measurements necessarily have to abstract from competency models and to focus on observable and assessable performance. This

inevitably neglects further important but less quantifiable competency aspects, such as situational judgments and complex behavior.

This close connection between the dimensions of measurement and practice is also not unilateral. Obviously, as described previously, practices do not depend only on measurements but also necessitate and initiate the development of suitable measurement instruments. As practice is the target application context, their design process necessarily embraces and depends on both of the potentially conflicting fields of theory, i.e., models and practice. Measurements should be based on well-researched and valid models and should, on the one hand, reliably operationalize the competencies included. On the other hand, they need to respect the requirements and restrictions of practice and application, e.g., in terms of design and expectations. To this extent, practices of teacher education impact the design, application and outcomes of respective measurements.

Another caveat concerning the relationship between measurements and practices in advancing media-related educational competencies in the context of German and US teacher education has been brought up in the context of the study presented in Paper 1, where a comparative measurement was applied using one national German instrument. Despite the extensive and scientifically sound translation process that sought to ensure the comparability and validity of the translation, problems connected to the application of one instrument for different contexts of practice could be identified in Chapter 8. This led to the conclusion that the measurement instrument applies more appropriately to practices in its own national context. Hence, the influence of measurements on practices, and conclusions drawn from results for the evaluation of practices are always subject to further careful considerations of both contexts. It can be concluded from these results that the mutual dependence of practices and measurements is again linked to contextual factors to a significant degree.

It is noteworthy in this context that this potential of competency measurements to evaluate systemic performance was not a central objective in most of the German and US cases analyzed. Studies seeking to summarize and evaluate the status of the advancement of media-related competencies in both countries rather focused on the spread of obligatory study contents and respective regulations, as presented by Bertelsmann Stiftung et al. (2018) or Kleiner et al. (2007). Within the frame researched in this work, the only attempt to evaluate educational practices through a competency measurement was presented by the M<sup>3</sup>K project, with limitations in terms of validation and transferability applying as described. Most measurement instruments from the US context that built on TPACK rather served to evaluate individual knowledge or performance within the frame of US initial teacher education. This leads to the research desideratum of enhancing and further researching systematic approaches to the evaluation of educational processes, also with respect to competency acquisition.

### *12.1.3 Models and practices of advancing media-related educational competencies*

Finally, the interdependencies described also suggest mutual references between the dimensions of modeling and advancing media-related educational competencies. In Part III, it was found in the expert interviews that theory-based models can have a certain influence on practices in initial teacher education if stakeholders, e.g., teacher educators, consider them a basis for selecting contents and for orientation and structure. This was described by one German expert with regards to the M<sup>3</sup>K model, which is used at his institution as a reference for the structuring of media-related study offers. Furthermore, it was pointed out that state-wide developments in initial teacher education practices were fostered based on Bremer's model. Such applications of a model to practices in initial teacher education have also been noted in the US context, where some study programs or even state standards are systematically aligned to TPACK or to the ISTE standards in particular. Hence, the influence of models on practices depends on largely comparable stakeholders both in Germany and the USA: on a smaller scale, teacher educators can decide individually to use models as a reference, and on a systemic level, state standards or exam regulations may increase significance of models or standards on a larger scale. This way, models can suggest contents for practices. They can define their outcomes and shape their curricula and contribute to a systematization of the whole media-related education if applied successfully. Consequently, models and research related to models were defined as an own dimension on the micro level in the analysis of stakeholders and conditions for practices of advancing the respective competencies (cf. Chapter 11.4).

On the other hand, practices of advancing media-related educational competencies also impact the respective competency models. Practice is the background against which models are developed. Practices of advancing media-related educational competencies are the ground on which contents and emphases for models are identified and on which their development is stimulated or necessitated. Hence, practices in initial teacher education, as a background characteristic of models, have been included in the identification of distinctive model features in Part I. It was highlighted that different practices of advancing media-related educational competencies and respective reference frames have an impact on the emphases and contents of respective models. In this context, the M<sup>3</sup>K model illustrated an example which referred quite closely to the context of German teacher education practices; consequently, the model places emphasis on theory-based competencies, which is consistent with its national reference frame. Further examples of models directly influenced by experiences in practices of teacher education include the previously described project-based German frameworks by Tulodziecki and Bremer. Likewise, the US TPACK model and the TETCs build on experiences of their authors in US initial teacher education and are thus closely linked to the dimension of practice.



All in all, these findings lead to the conclusion that the relationships between the three dimensions of modeling, measuring and practices of advancing media-related educational competencies in Germany and the USA show a significant number of parallels. Figure 8 summarizes and highlights these relationships; overall, they can be confirmed to be inherent to the separate dimensions and of key importance for their acknowledgment, interpretation, and application in both national contexts. However, it is also important to pay attention to the abstractive orientation of Figure 8; focusing on these dimensions and their interplay, it thus necessarily neglects further important influences. Part III revealed the relevance of stakeholders for teacher education practices, and comparable considerations have been suggested also in the contexts of modeling and measuring: for example, the role of professional associations has been discussed extensively, e.g., with regards to the US organizations ISTE and NAMLE who published their own standards and thus directly impact the dimension of modeling. Measurement practices are also influenced by further conditions, such as ethical and legal restrictions, going beyond the interdependency with models and practices in initial teacher education. Hence, Figure 8 represents a focused perspective narrowed down to three dimensions that are, again, all subject to their own individual stakeholder networks.

In light of this conclusion, one aspect which is clearly relevant for all three dimensions is the overall research and experience background coming into play in each process of modeling, measuring or advancing media-related educational competencies. Literature and research, on the one hand, and practice and experience, on the other, function as an important connector between the three. Models, measurements and practices can be based mainly on literature and research or mainly on practice and experience – or they can be built on both orientations, which are not mutually exclusive. They can be understood as two extremes of a continuum that every model, every measurement and every practice of advancement can be allocated to. For example, the formerly discussed TPACK model with its inductive research approach is heavily impacted by the experiences the authors collected in the course of their work as teacher educators, and it builds on their conclusions from practice. Yet, as the authors' practice was also shaped by their research expertise and the tradition of professionalization research as presented by Shulman (1986), research and literature are still important for the development of TPACK. The M<sup>3</sup>K model with its deductive approach also builds on research and its authors' experiences in German teacher education. In this way, all three dimensions are influenced to varying degrees both by literature and research and by experience and practice. Again, this impact is mutual: e.g., new models will feed into the body of relevant literature; practices of advancing media-related educational competencies will form researchers' relevant practical experience; and measurements add to both dimensions as well.

The interconnectedness and interdependency of modeling, measuring and practices of advancing media-related educational competencies overall reveal a strong connection between the three dimensions. It has become clear now that a thorough consideration of one of the three dimensions which neglects the others is likely to be deficient. These conclusions are of high relevance for further considerations and ongoing research in this field: it will be beneficial for respective works to pay attention to the networks of relationships identified to enhance understanding, coherence and validity in the context of any of the three dimensions.

### **12.2 Conclusions for Further Research and New Perspectives**

The conclusions outlined are based on considerations from an international comparative perspective, and they stem from, and apply to, the contexts of Germany and the USA. It was argued in the introduction that the international comparative perspective was expected to widen the viewpoint and to allow for additional insights which go beyond the context of a single research background. Hence, the aspect of nationality and the impact of national peculiarities have been acknowledged, emphasized and discussed, and the analysis of the connections between the three main dimensions has been found to be applicable in the context of both countries. It will be revealing for further research works to include the perspectives of further countries to validate and enrich the conclusions drawn.

With regard to Germany and the USA, desiderata for further research can be derived on all three levels of modeling, measuring and advancing media-related educational competencies. Competency models have been described as an important theoretical basis with varying relevance for practice. This relevance is closely connected to factors like the intended purpose of model application or its background. It has been pointed out that the applicability of models and measurement instruments which strongly depend on national influences can be limited in international contexts, a caveat which justifies the recently increasing interest in internationally applicable competency models like DigCompEdu and also emphasizes the importance of international research as applied in this dissertation. Yet national competency models have also proven valuable, especially with regard to the orientation and systematization of processes on a national level, which is subject to specific and individual influences and may therefore not be represented appropriately by a general international model. Hence, the findings presented in this work lead to the conclusion that it will be worthwhile for future related research to acknowledge the mutual interdependencies between national and international competency models and to open up perspectives to contexts beyond one's own background to appreciate the benefit offered by different types of models for different purposes and functions.

Corresponding with these findings, Part II of this dissertation pointed out the importance of aligning measurements carefully with their background and purpose. In this context, deficiencies on different levels have been identified with the measurement instruments analyzed for DigCompEdu, TPACK and M<sup>3</sup>K, ranging from partly inconsistent items, as in the case of DigCompEdu, to questionable item-construct fit, as in the case of TPACK, or unsatisfying validity, as in the case of M<sup>3</sup>K. In terms of research desiderata, there is obviously a need for fostering the systematic and application-specific development of reliable and valid measurement instruments for DigCompEdu, TPACK and M<sup>3</sup>K. However, the issue of validation has been analyzed to be closely linked to the model design and instrument orientation. It is noteworthy that the M<sup>3</sup>K measurement is the only instrument identified in the study that seeks to systematically and objectively assess the level of competence among a certain preservice teacher population in order to draw conclusions on a systemic level and to ultimately contribute to the improvement of practices. On the other hand, the predominance of self-assessment instruments for DigCompEdu and TPACK stands out. Given the explicit purpose especially of DigCompEdu to offer guidance for systemic change and to contribute to the improvement of practices, it appears necessary to enrich the measurement methodology and to address the challenges of objective measurements in future developments to achieve reliable and valid conclusions and thus fulfill the claims made by the respective model.

However, the expert interviews presented in Part III revealed another need for future research. Criticism was expressed towards current practices in measuring competencies regarding the interdependency of measurement and practice. It seems that in many cases, measurable and quantifiable outcomes prevail in the perception of competency aspects that are important for advancement in initial teacher education – an observation which is critical against the background of competence being a construct which has to be operationalized for measurements. Such a perspective neglects the multifold functions competency measurements can have, and it seems desirable to further investigate the role that different types of competency measurements can and should indeed play in educational contexts both on national and international levels.

To conclude, a certain bias concerning applications of measurement instruments can be abstracted. On the one hand, it is desirable to assess and evaluate competencies systematically in favor of grounded conclusions for innovation and improvement practices, while, on the other hand, there is a certain hesitance to operationalize and quantify competencies at the level of teacher educators. Yet it can be argued that these two approaches are actually not contradictory. Instead, different expectations toward measurement processes on systemic and individual levels support the claim of carefully aligning measurement instruments with their respective

application context, and they emphasize the need for a scientific width and richness of approaches, depending on the intended context and results.

Finally, with regard to practices of advancing media-related educational competencies, Part III revealed a network of factors influencing respective processes. Centrally, there is a tension between systemic requirements and barriers, on the one hand, and work at the level of teacher educators, on the other. Efforts of varying success are being made on both sides to advance and improve respective practices. Current efforts in educational research to focus on teacher educators and to improve their competencies and enhance both their willingness and abilities to integrate respective contents into teacher education programs appear consequential against this background. Examples for such approaches are the recent Technology Infusion approach and the research on Teacher Educator Technology Competencies in the USA (Foulger et al. 2017; Foulger, Wetzel, and Buss 2019) or the European ITELab project (European Schoolnet [EUN] 2019). As described in Chapter 4.2, the TETCs research aims to explore the competencies teacher educators need in the context of advancing preservice teachers' media-related educational competencies and to offer guidance for the professional development of teacher educators. In light of the stakeholder role of teacher educators identified in Part III, it is confirmed now that such an orientation is a valuable and important contribution to the overall improvement of current practices. The European ITELab project also addresses teacher educators by researching their digital competencies, as suggested by DigCompEdu, and it offers materials for use in initial teacher education across Europe that allow for an easy and low-threshold approach to advancing respective competencies with preservice teachers (European Schoolnet [EUN] 2019). Also in this way, teacher educators are addressed and supported in their professional development. These examples illustrate how the overall field of media-related initial teacher education can benefit from a deepened focus on the role and development of teacher educators, and they suggest an ongoing and deepened analysis of the level of teacher educators, which is evolving but currently is often neglected.

It is important to note in this context that the challenges of improvement and change both on systemic and teacher educator levels are global. Despite national peculiarities and differences, it has become evident that teacher education systems both in the US and in Germany face comparable challenges with regards to the advancement of media-related educational competencies. Against the background of global mediatization and digitalization, it seems reasonable to assume that the relevance of advancing respective practices is not restricted by national borders. This finding inevitably leads to questions about the desirable strategic orientation of processes of modeling, measuring and advancing media-related educational competencies and ultimately of educational processes in general. The advantages of aligning respective processes to international models, guidelines and standards have been

discussed previously and stand out once more in the light of the global challenges connected to the digitalization of teaching and learning processes. Yet it is important to acknowledge the individual characteristics constituting a national or cultural context and not to interfuse an open and international orientation with a neglect of local and national conditions. Hence, enhancing global educational research through international comparative research approaches, and thus by combining efforts and knowledge from various media-related contexts, is a vital contribution to the advancement of research on media-related educational competencies on local levels as well. Taking into account the previous results, national and international research orientations and approaches should be balanced and used to amend and enrich the perspectives without substituting one for another.

Overall, this research objective needs to be focused on continuously in general educational contexts, but it also needs a specific focus with regards to models, measurements and practices of advancing media-related educational competencies. A respective broad and inclusive perspective will contribute to the systematic improvement of the media-related education of preservice teachers and, through this, ultimately facilitate a contemporary and successful preparation of future teachers for the multifold challenges of teaching and learning in a digitalized and mediatized world.

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