Conceptualizations of the TPACK Framework

This is an amendment to a previous version

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This is a Rmd-template for protocols and reporting of systematic reviews and meta-analyses. It synthesizes three sources of standards:

- PRISMA-P
- PROSPERO
- MARS

The template is **aimed at**

- guiding the process of planning the systematic review/ meta-analysis
- providing a form for preregistration (enter your text, export as standalone html, upload as preregistration)

We are aware that MARS targets aspects of reporting after the systematic review/ meta-analysis is completed rather than decisions and reasoning in the planning phase as PRISMA-P and PROSPERO. MARS nevertheless provides a good framework to determine crucial points for systematic reviews/ meta-analyses to be addressed as early as in the planning phase.

Standards have been partially adapted. Click 'show changes' to see changes and reasons for change.

General

Working Title

Cleaning up the Mess: A Systematic Review on the Various Understandings of the Technological, Pedagogical and Content Knowledge (TPACK) Framework in Interventions

Type of Review

Systematic Review

Link to Registration

This form is used as registration

Anticipated start and completion date

Start: October 2020

Anticipated Completion Date: August 2021

Stage of Review

The review has not yet started [yes/no]: No

Review stage	Started	Completed
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

Names, Affiliations, Contact

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Collaborators

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- Apart from the review team members, there will be no (external) collaboration. ##

Amendment to a previous version

After our initial screening, more than *N*=1500 papers were to be coded. As these were too many, we decided to adapt the Inclusion Criteria (see below). Accordingly, few changes have been made to the research questions. For that reason, we decided to pre-register an updated version (=this form) to our first version. The first version was uploaded on 27-Oct-2020 and can be found here: http://dx.doi.org/10.23668/psycharchives.4278

Funding sources, sponsors and their roles

Conflict of Interest

No conflict of interest.

Introduction

Rationale

When it comes to school or education as such, the discussion about the use of digital media has become ubiquitous. However, recent studies indicate that teachers still rarely use digital technologies for educational purposes, and if they do, they fail to integrate them into teaching in a didactically meaningful manner (Farjon et al., 2019). One of the main boundary conditions of successful technology integration, that researchers have identified, is the professional knowledge of teachers (Petko, 2012). Accordingly, to use technologies in classrooms purposefully, teachers need specific knowledge that is tailored around the use of digital technologies. One of the most recited and adopted models used to describe such knowledge is the TPACK (**t**echnological, **p**edagogical **a**nd **c**ontent **k**nowledge) model by Mishra and Koehler (2006). The TPACK model captures the idea of bringing together and connecting basic knowledge components (i.e., knowledge about technology, pedagogy and content) to form a new central form of knowledge – TPACK (technological, pedagogical and content knowledge. In literature, TPACK has evolved to become *the* central focus of researchers when it comes to knowledge regarding technology integration (Kim & Lee, 2018). Therefore, the TPACK model is often used as a theoretical basis for the development of interventions within teacher education that aim at fostering TPACK. However, the vast and

different approaches to interventions that have been proposed within the TPACK community show how differently TPACK is understood among researchers (Voogt et al., 2013).

Against this background, we conduct a systematic review that attempts to clarify and systematize existing understandings of TPACK that exist in research. More precisely, we are interested in examining if TPACK researchers – in their endeavours of fostering TPACK – have put emphasis on specific TPACK components (i.e., subdomains of TPACK: Technological Knowledge, Content Knowledge, Pedagogical Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge and Technological Pedagogical and Content Knowledge) while possibly neglecting others. Therefore, we will systematically analyse papers which discuss strategies to develop (pre-service) teachers' TPACK. These papers mostly either consist of descriptions of a (pre-service) teacher training or empirical investigations of the effectiveness of interventions. As a result, the focus on such intervention studies[1] allow us best to understand the researchers' understanding of TPACK. Moreover, we will systematically investigate the subsample of those studies that applied measurement instruments for TPACK. This will enable a deeper understanding of the empirical applicability of existing TPACK conceptualizations.

This systematic review will help to organize and understand different existent TPACK conceptualizations in research and its impact on the design of teacher education, and thereby paves the way for fruitful applications of this highly complex framework in the future.

References

Farjon, D., Smits, A., & Voogt, J. (2019). Technology integration of pre-service teachers explained by attitudes and beliefs, competency, access, and experience. *Computers & Education, 130*, 81–93. https://doi.org/10.1016/j.compedu.2018.11.010

Kim, S.-W., & Lee, Y. J. (2018). The Effects of the TPACK-P Educational Program on Teachers' TPACK: Programming as a Technological Tool. *International Journal of Engineering & Technology*, *30*(7), 636–643. https://www.doi.org/10.14419/ijet.v7i3.34.19405

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teacher knowledge. *Teachers College Record*, *108*(6), 1017-1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Petko, D. (2012). Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the "will, skill, tool" model and integrating teachers' constructivist orientations. *Computers & Education*, *58*, 1351–1359. https://doi.org/10.1016/j.compedu.2011.12.013

Voogt, J., Fisser, P., Roblin, N. P., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge - a review of the literature. *Journal of Computer Assisted Learning, 29*(2), 109–121. https://doi.org/10.1111/j.1365-2729.2012.00487.x

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[1] Please note that for convenience reasons, we will in the following use the label "intervention studies" or "interventions" for *all* papers that discuss strategies to develop TPACK regardless of whether they are of empirical or theoretical nature.

Research Questions

RQ1) Which subcomponents of TPACK (i.e., TK, CK, PK, PCK, TCK, TPK, TPCK) have been primarily focused in interventions?

RQ2) Which test instruments have been used to measure TPACK in empirical studies and which subcomponents are mainly addressed in these test instruments?

RQ3) Is there a correlation between the different foci sent in interventions and measurement instruments accordingly?

Exploratorily, we will investigate differences between domains (e.g., science, humanities, languages) with regard to the research questions RQ1 and RQ2.

Methods

Eligibility: Inclusion and Exclusion Criteria

Inclusion criteria

- Interventions that aim at fostering ICT-related teaching competencies that are framed within the TPACK-framework
- Peer-reviewed journal articles and dissertations

Exclusion criteria

- No full text available
- Papers that are not written in English
- Papers in which TPACK (or adoptions and extensions thereof) was not explicitly mentioned in the title or abstract
- Papers that lack detailed information on how ICT-competencies of (pre-service) teachers within the framework of TPACK were attempted to foster (i.e. no description of intervention's content)
- Survey studies
- Delphi studies

Sources of Search: List and Rationale

- data bases:
    - Web of Science
    - PsychINFO
    - ERiC
    - ScienceDirect
    - ProQuest Dissertations

- o first 100 results from google scholar
- backwards search
  - o After screening abstracts and titles: We use the three latest reviews on TPACK (or adoptions and extensions thereof) and screen their references

Search Strategy

Search String

((TPACK OR TPCK OR "technological pedagogical content knowledge" OR "technological-pedagogical-content-knowledge" OR "technological pedagogical and content knowledge") AND teacher*)

Additional Specifications Used

- language: English
- time span: 2005-2020

Note: In 2005, the acronym TPACK was first used by Mishra and Koehler. Thus, to offer a complete picture on existing TPACK conceptualizations, all TPACK contributions that have been published since 2005 are taken into consideration.

Data Management Tools Used

- Rayyan (https://rayyan.qcri.org/)
- Citavi (https://www.citavi.com/de)

Data Extraction (Selection of Studies)

Two independent reviewers conduct every of the following steps:

1. screening titles and if we cannot make a statement based on the title we will screen the abstract
2. screening all abstracts
3. screening full texts

At each of these three steps, articles will be included if the inclusion criteria apply and none of the exclusivity criteria apply. If this is not the case, articles will be excluded. If it is not clear whether articles should be included or excluded, these articles will be labelled as "maybe" and then discussed among the raters until consens is reached. If there are disagreements among the raters regarding the inclusion or exclusion of a certain publication, this publication will be discussed together in more detail until consens is reached.

Method of Extracting Data & Information (from Reports)

- Studies will be coded in Rayyan by two independent raters using the "inclusion", "exclusion" and "maybe" labelling function.

- To extract detailed information on the included studies, a standardized Excel dashboard that produces a relational database will be established and used by the two independent raters.
- All extracted data and information will be analyzed for interrater agreement and discrepancies will be discussed (see also 3.5).

List and Description of Data and Information Extracted

- *General information on the publication*, such as publication status, publication year, authors' names and their disciplines
- *Specific information on the authors*, such as discipline of the authors (general teacher educators, content specialists, education professors, etc.)
- *General information on empirical papers,* such as sample size, sample group (pre-service teachers, in-service teachers), country the study was conducted, gender, subject domain, which kind of TPACK measurement was used (self-report, performance-based, observations, etc.)
- *Specific information on measurement instruments,* such as the focus of the TPACK subcomponents within the applied measurement instruments, reliability criteria, validity criteria
- *Specific information on intervention*, such as focus of the TPACK subcomponents in instructional features (i.e., TK, PK, CK or intersections thereof), length of the intervention, modality of participation (mandatory, obligatory), modality of implementation (offline, online, blended), preparation strategies used (reflection, collaboration, authentic experience, etc.)
- *Specific information on measurement instruments,* such as the focus of the TPACK subcomponents within the applied measurement instruments, reliability criteria, validity criteria

Note: This list might be subject to extensions and/or adoptions as we start with the revision process.

Effect size transformation from individual studies

not relevant as this is a review, not a meta-analysis.

Risk of Bias in Individual Studies

Through the systematic approach used to obtain our final sample, the general quality of included publications should be high. To account for individual difficulties and possible bias within publications, a qualitative content analysis approach will be conducted for each publication individually. By doing so, we can make sure to detect and properly reflect upon (empirical) difficulties that we come across in individual publications.

Results

Strategy for Data Synthesis

After the final selection of the sample from the revision process, a content analysis approach will be conducted. This means, that for each of the selected publication, relevant information will be clustered and organized into units of meaning. These units of meaning carry information that will help in answering the research questions.

Our analytical approach can be considered both deductive as well as inductive. It will be deductive in the sense that our starting point for developing the coding scheme will be the TPACK model and the complex interplay of its subdomains. On the other hand, our approach includes inductive characteristics as our coding scheme might be supplemented by further labels extracted from individual contributions as we conduct our sample.

Our dichotomous approach will contribute to a comprehensive understanding of TPACK helping future researchers to theoretically and empirically apply the complex framework of TPACK.