Another jingle-jangle fallacy? Examining the validity of Technological Pedagogical and Content Knowledge (TPACK) self-report assessments

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Contents

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Another jingle-jangle fallacy? Examining the validity of Technological Pedagogical and Content Knowledge (TPACK) self-report assessments

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NA

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NA

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Conflict of Interest

No

Introduction

Rationale

Recent research provided evidence that teachers' professional knowledge regarding the adoption of educational technologies is a central determinant for successful teaching with technologies (Petko, 2012). One prominent conceptualization of teachers' professional knowledge for teaching with technology is the technological-pedagogical-content-knowledge (TPACK) framework established by Mishra and Koehler (2006). Based on this framework, TPACK encompasses three generic knowledge components (technological knowledge TK, pedagogical knowledge PK, content knowledge CK), three intersections of these knowledge components (technological-pedagogical knowledge TPK, technological-content knowledge TCK, pedagogical-content knowledge PCK) and TPACK as an integrated knowledge component "that represents a class of knowledge that is central to teachers' work with technology" (p. 1028, Mishra & Koehler, 2006), see Figure 1.

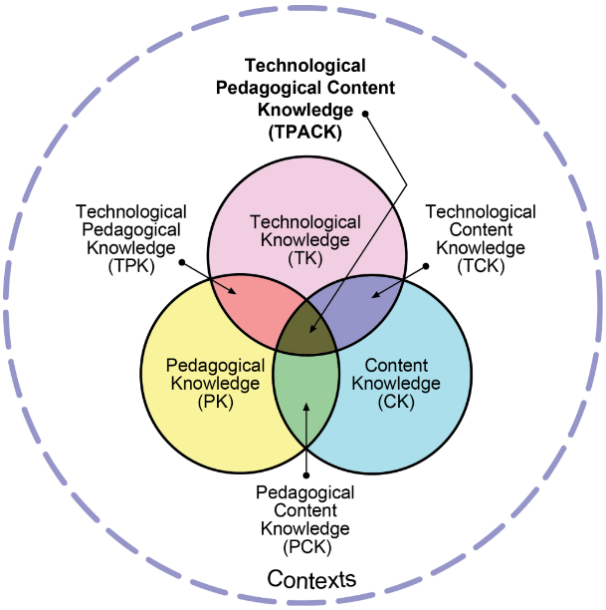

Figure 1. TPACK Model (Mishra & Koehler, 2006; © 2012 by tpack.org)

The most prominent questionnaire to assess TPACK is the self-report questionnaire by Schmidt et al. (2009). This questionnaire encompasses items on the different knowledge components which ask teachers to self-evaluate their confidence to fulfill a task (e.g., an item for TCK is "I know about technologies that I can use for understanding and doing mathematics", and for TPK is "I can choose technologies that enhance the teaching approaches for a lesson."). Recently, researchers claim that this self-report questionnaire (and the different extensions and adaptions thereof) rather tap into teachers' self-efficacy beliefs about teaching with technology than their available knowledge (Scherer et al., 2018; Lachner et al., 2019). Based on the conceptualization of self-efficacy beliefs as the subjective perception of one's own capability to solve a task (Bandura, 2006), researchers recently argue that the self-report TPACK might be highly intertwined with teachers' self-efficacy beliefs. Related research suggests that the use of self-report TPACK might be challenging during interpreting the results of empirical studies (Abbitt, 2011; Joo, Kim, & Li, 2018; Fabriz et al., 2020). Therefore, the use of self-report TPACK might induce a jingle-jangle fallacy (Gonzalez et al., 2020; Kelley, 1927). Jingle-jangle fallacies describe a lack of extrinsic convergent validity in two different ways: On the one hand two measures which are labeled the same might represent two conceptually different constructs (*jingle fallacy*). In the present case, self-report TPACK might differ from teachers' knowledge for technology-enhanced teaching to a larger extent than previous research suggests. On the other hand two measures which are labeled differently might examine the same construct (*jangle fallacy*). Accordingly, self-report TPACK and self-efficacy beliefs towards technology-enhanced teaching might be similar constructs with comparable implications on teachers' technology integration (see e.g., Marsh et al., 2020 for an investigation of jingle-jangle fallacies). However, to date a systematic analysis of the problematic validity of self-reported TPACK is missing.

Against this background, three complementary approaches will be applied in this paper to examine the validity of self-reported TPACK.

First, we will meta-analytically analyze, how the different knowledge components of the TPACK model (i.e., TK, CK, PK, TCK, TPK, PCK) are related to each other across studies when examined with self-report TPACK questionnaires. Measures that depict TPACK components that are more proximal to each other or are intersections of each other in the model should show higher correlations than more distal measures or measure that don't intersect (e.g., TK should correlate higher with TCK than with PCK).

Second, potential jingle fallacies of self-report TPACK and teachers' knowledge for technology-enhanced teaching will be examined. Hence, it will be investigated if the two measures represent the same concepts as proposed by researchers (e.g., Schmidt et al., 2009). Therefore, the extent to which self-reported TPACK and more objective measures of teachers' knowledge for technology-enhanced teaching are related to each other will be examined. If, as proposed, self-report TPACK represents teachers' knowledge for technology-enhanced teaching, self-report TPACK should be highly related to the quality of technolog use for teaching (see e.g., Kunter et al., 2013; Ericsson, 2006 for the importance of teacher knowledge for generic teaching quality). To investigate the relationship of self-reported TPACK and performance-based measures of teachers' knowledge for technology-enhanced taching, empirical studies that examine these measures such as studies that investigate the role of self-reported TPACK for the quality of technology-enhanced lesson planning (e.g., Backfisch et al., 2020; Kopcha et al., 2014) or test-based approaches (e.g., Akyuz, 2018; Krauskopf & Forssell, 2013; So & Kim, 2009) will be reviewed.

Third, potential jangle fallacies of self-report TPACK and self-efficacy beliefs towards technology-enhanced teaching will be examined. Therefore, the magnitude of the correlations of self-reported TPACK and self-efficacy beliefs towards technology-enhanced teaching will be compared. Futhermore, the extent to which both measures are related to teachers' technology integration (e.g., frequency of technology integration) will be analyzed. If self-report TPACK and self-efficacy beliefs are related to the same magnitude to outcome variables, both measures might represent the conceptually similar construct.

References Abbitt, J. T. (2011). Measuring technological pedagogical content knowledge in preservice teacher education: A review of current methods and instruments. *Journal of Research on Technology in Education*, 43(4), 281–300. https://doi.org/10.1080/15391523.2011.10782573 Akyuz, D. (2018). Measuring technological pedagogical content knowledge (TPACK) through performance assessment. *Computers & Education*, 125, 212–225. https://doi.org/10.1016/j.compedu.2018.06.012 Backfisch, I., Lachner, A., Hische, C., Loose, F., & Scheiter, K. (2020). Professional knowledge or motivation? Investigating the role of teachers' expertise on the quality of technology-enhanced lesson plans. *Learning & Instruction*, 66, 101300. https://doi.org/10.1016/j.learninstruc.2019.101300 Bandura, A. (2006). Guide for constructing self-efficacy scales. In *Self-efficacy beliefs of adolescents* (pp. 307–337). https://doi.org/10.1017/CBO9781107415324.004 Ericsson, K. A. (2006). The influence of experience and deliberate practice on the development of superior expert performance. *The Cambridge Handbook of Expertise and Expert Performance*, 38, 685-705. Fabriz, S., Hansen, M., Heckmann, C., Mordel, J., Mendzheritskaya, J., Stehle, S., Schulze-Vorberg, L., Ulrich, I., & Horz, H. (2020). How a professional development programme for university teachers impacts their teaching-related self-efficacy, self-concept, and subjective knowledge. *Higher Education Research & Development*, 1–15. Gonzalez, O., MacKinnon, D. P., & Muniz, F. B. (2020). Extrinsic Convergent Validity Evidence to Prevent Jingle and Jangle Fallacies. *Multivariate Behavioral Research*, 1–17. Joo, Y. J., Park, S., & Lim, E. (2018). Factors influencing preservice teachers' intention to use technology: TPACK, teacher self-efficacy, and Technology Acceptance Model. *Educational Technology and Society*, 21(3), 48–59. Kelley, T. L. (1927). *Interpretation of educational measurements*. Kopcha, T. J., Ottenbreit-Leftwich, A., Jung, J., & Baser, D. (2014). Examining the TPACK framework through the convergent and discriminant validity of two measures. *Computers & Education*, 78, 87–96. https://doi.org/10.1016/j.compedu.2014.05.003 Krauskopf, K., & Forssell, K. (2013). I have TPCK! – What does that mean? Examining the External Validity of TPCK Self-Reports. *Proceedings of Society for Information Technology & Teacher Education International Conference 2013*, 2190–2197. http://www.stanford.edu/~forssell/papers/SITE2013_TPCK_validity.pdf Kunter, M., Klusmann, U., Baumert, J., Richter, D., Voss, T., & Hachfeld, A. (2013). Professional competence of teachers: Effects on instructional quality and student development. *Journal of Educational Psychology*, 105, 805–820. https://doi.org/10.1037/a0032583 Lachner, A., Backfisch, I., & Stürmer, K. (2019). A test-

based approach of Modeling and Measuring Technological Pedagogical Knowledge. *Computers & Education*, 103645. https://doi.org/10.1016/j.compedu.2019.103645 Marsh, H. W., Pekrun, R., Parker, P. D., Murayama, K., Guo, J., Dicke, T., & Arens, A. K. (2019). The murky distinction between self-concept and self-efficacy: Beware of lurking jingle-jangle fallacies. *Journal of Educational Psychology*, 111(2), 331. 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. 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 Scherer, R., Tondeur, J., & Siddiq, F. (2017). On the quest for validity: Testing the factor structure and measurement invariance of the technology-dimensions in the Technological, Pedagogical, and Content Knowledge (TPACK) model. *Computers & Education*, 112, 1-17. https://doi.org/10.1016/j.compedu.2017.04.012 Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK) the development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, 42(2), 123-149. https://doi.org/10.1080/15391523.2009.10782544 So, H. J., & Kim, B. (2009). Learning about problem based learning: Student teachers integrating technology, pedagogy and content knowledge. *Australasian Journal of Educational Technology*, 25(1), 101–116. https://doi.org/10.14742/ajet.1183

Research Questions

RQ1: How are the different knowledge components of the TPACK model related to each other, when examined with self-report TPACK questionnaires?

RQ2: Does the use of self-reported TPACK questionnaire constitute a jingle fallacy with teachers' knowledge for technology-enhanced teaching?

RQ2a: To what extent is self-reported TPACK related to performance-based measures of knowledge for technology-enhanced teaching?

RQ3: Does the use of self-reported TPACK questionnaire constitute a jangle fallacy with self-efficacy beliefs?

RQ3a: To what extent is self-reported TPACK related to self-efficacy beliefs?

RQ3b: To what extent are self-reported TPACK and self-efficacy beliefs differently related to self-reported technology integration?

Methods

Eligibility: Inclusion and Exclusion Criteria

Inclusion citeria:

Empirical questionnaire studies that investigate TPACK with a self-report questionnaire such as Schmidt et al. (2009) or extensions of thereof (e.g., Koh et al., 2014; Scherer et al. 2017)

Empirical studies that investigate TPACK of teachers or educators across all pedagogical fields (either pre-service, trainee or in-service teachers, principals or teacher educators in all educational fields and school levels)

Papers which are written in English

Papers that provide the necessary correlations to conduct the analyses, or information that can be used to compute the correlations, or if the authors provide the information on demand

Peer-reviewed journal articles, conference proceedings, book chapters and dissertations

Papers must be accessible through full text documents.

Papers that provide one or more of the following information:

Quantitative self-report TPACK (at least one of the components of the TPACK model)

Correlations / factorial structure of the different components of TPACK

Self-efficacy measure(s) that tap into a component of teachers' self-efficacy of technology-enhanced teaching (e.g., technological self-efficacy, general teaching-related self-efficacy)

Relation of self-report TPACK and self-efficacy measure(s)

Outcome measure(s) of teachers' technology integration (quantity or quality measures; self-report or performance-based measures (e.g., test-based, lesson plans, observer ratings))

Exclusion criteria:

Participants are pupils

Case studies

Sources of Search: List and Rationale

Adequate databases: Web of Science, ERiC, ScienceDirect, IEEE Xplore Digital library, LearnTechLib, PsychInfo, ProQuest Dissertations, google scholar (first 100 results)

Papers from previous reviews on TPACK

Search Strategy

Search String/Query: (TPACK OR TPCK OR "technological pedagogical content knowledge" OR "technological-pedagogical-content-knowledge") AND NOT (virus OR health OR chromatography OR cell)

Data Management Tools Used

rayyan (https://rayyan.qcri.org/welcome) to include or exclude and label papers by several raters

Selection of Studies

Two independent raters will conduct a two-step approach of inclusion and exclusion based on our inclusion and exclusion criteria: 1) screening all titles and abstracts, 2) screening full texts. As a further safeguard a backward search will be conducted in which review articles and book chapters published in 2020 dealing with TPACK will be screened and searched for appropriate literature that is not yet included in our meta-analysis.

Besides directly including and excluding papers, raters can choose the "maybe" category. All papers with disagreement of whether to include or exclude and especially the papers in the maybe category will be discussed among raters based on the inclusion criteria until agreement is reached.

Method of Extracting Data & Information (from Reports)

Studies will be coded in Rayyan by two independent raters using the detect duplicates, inclusion/exclusion/maybe and labeling function.

To extract detailed information on the included studies, a standardized Excel or self-programmed dashboard that produces a relational database will be established and applied by two independent raters.

All extracted data and information will be analyzed for inter-rater agreement and discrepancies will be discussed.

List and Description of Data and Information Extracted

Study characteristics:

Publication status

Publication year

Context of using TPACK (e.g., psychometric study, study to explore the relations to other variables [e.g., in a SEM], studies aimed at identifying profiles, . . .)

Sample characteristics:

Sample size

Profession: teacher, teacher educators. . .

Teaching experience: pre-service teachers, in-service teachers. . .

Age

Country

Gender (% female)

School level: elementary / primary / secondary / university teachers. . .

Subject domains

Type of study:

Experimental setting / survey

Intervention

Cross-sectional / longitudinal

Measures applied:

TPACK self-report (e.g., Schmidt et al., 2009; Scherer et al., 2017)

TPACK dimensions covered

Reliability (coefficient type, value)

Validity evidence/additional variables

Type of self-efficacy measures (e.g., general teaching related self-efficacy; technology-related self-efficacy)

Reliability (coefficient type, value)

Validity evidence/additional variables

Type of performance-based measures of TPACK (e.g., lesson plans, test-based)

Reliability (coefficient type, value)

Validity evidence/additional variables

Type of outcome measures (e.g., frequency of technology use general / during teaching; qualitative measure)

Reliability (coefficient type, value)

Validity evidence/additional variables

Quantitative reports: Correlations and effect sizes

Self-report TPACK & self-efficacy measure

Self-report TPACK & outcome measure

Self-efficacy measure & outcome measure

Self-report TPACK & performance-based measure of TPACK

In each case: type of correlation (e.g., pearson), type of correlation extracted (e.g., directly from paper, computed based on information in paper, based on raw data if provided by authors)

Effect Size Transformation from Individual Studies

To investigate the magnitude of the correlations of the different measures investigated, Pearson correlation coefficient (r) will be needed and extracted resp. converted from the information provided in the papers included (based on the approach of Polanin & Snilstveit, 2016). To investigate differences of the synthesized correlations, we will apply Cohen's q.

Risk of Bias in Individual Studies

We will apply general criteria of study quality (e.g., sample sizes, reliability of applied measures see Valentine & Cooper, 2008 for a comprehensive overview of potential criteria).

Results

Strategy for Data Synthesis

Assuming that we identify sufficient empirical studies, we will apply meta-analytical inferential statistics to examine the research questions. Following suggestions by Gonzalez et al. (2020) we will investigate the magnitude of the correlations of different measures depending on the amount of identified studies either with William's equation or meta-analytical structural equation modelling (MASEM) approaches. Multiple correlations per study will not be aggregated to the study level. Instead, to address dependencies among these effect sizes, robust variance estimation and multilevel meta-analyses will be considered.

RQ1: Investigate the magnitude of the correlations of the different TPACK components

RQ2a: Investigate the magnitude of the correlation of self-report TPACK and the quality of technology-enhanced teaching.

RQ3a: Investigate the magnitude of the correlation of self-report TPACK and self-efficacy

RQ3b: Compare the magnitude of the correlation of self-report TPACK and outcome measures (e.g., frequency of technology integration) to the magnitude of the correlation of self-efficacy measures and outcome measures

Moderators/ Subgroups

Different moderators will be investigated to gain more insights on influential factors:

Different adoptions of self-report TPACK measures

Different types / focus of self-efficacy measures (e.g., general teaching self-efficacy v.s technology-related self-efficacy)

Different types of outcome measures of technology integration (e.g., self-report, lesson plans)

Assessment of Publication Bias

File-drawer analyses: p-curves for the correlations

Publication bias of single correlations:

Moderator effects of publication status (published vs. grey literature)

Fail-safe N analyses

Trim-and-fill analyses

Asymmetry tests of funnel plots

Discussion

Strength of Cumulative Evidence

We will examine the strength of our evidence by computing Cohen's q. Additionally, we will evaluate the overall strength of evidence based on the GRADE framework (Grading of Recommendations Assessment, Development and Evaluation) and examine the following dimensions: overall risk of bias based on publication bias and quality of included studies, inconsistency of findings across studies (if findings across studies are consistent or not), indirectness (if participants of studies are part of the target population).