Context and Technological Pedagogical Content Knowledge: A Content Analysis

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Abstract: Context is an important part of technological pedagogical content knowledge (TPACK), but there is evidence teachers' context has not been included in descriptions, explanations, or operationalizations of TPACK among publications that apply the TPACK framework (Kelly, 2010). Furthermore, when context is included, there is evidence for the widespread variation in meaning when context is included in descriptions of TPACK (Porras-Hernandez & Salinas-Amescua, 2013). The purpose of this study is to establish the inclusion and meaning of context in prior TPACK research, building upon prior work by 1) attending to the needs that followed Kelly's (2010) prior research, 2) attending to needs that followed Salinas-Amescua and Porras-Hernandez's (2013) prior research, and 3) examining the most recent empirical TPACK publications. This study will contribute to the development of theories of how context and contextual factors affect the ability to teach with technology as understood through TPACK.

Introduction

Context, defined in this study as the conditions around the knowledge and activities of teachers, is important to research conducted in social science fields from anthropology and sociology to psychology and education (Burke, 1999). Educational researchers have more recently embraced what Tabak (2004) characterized as a *contextual turn* that is, a focus upon "studying individuals and groups of individuals in context" (p. 225). Technological pedagogical content knowledge (TPACK) is a theoretical framework of the knowledge needed to teach with technology. Mishra and Koehler (2006) developed TPACK in response to the absence of theory to guide the integration of technology into education. Since its introduction, "the notion of TPACK has been rapidly extended across the fields of professional development and technology integration" (Voogt, Fisser, Roblin, Tondeur, & van Braak, 2012, p. 110).

Education researchers approach context in different manners; many times these approaches are not made explicit in publications. Being explicit about meaning is important because some educational researchers "have developed a folk definition of context" researchers think they "understand but truly do not use coherently or cohesively" (Turner & Meyer, 2000, p. 83). This sentiment is echoed by the authors of the first chapter of the *APA Educational Psychology Handbook*: A critical task for future research is "consolidating synonymous constructs and using terminology consistently," for "the sheer number of perspectives regarding what context is and how it relates to learning is staggering" (Alexander, Murphy, & Greene, 2011, p. 20). Similarly, a special issue of *Educational Psychology*, which focused on the nature of context to issues of teaching and learning, illustrated and argued for the importance of studying individuals and groups of individuals in context (Anderman & Anderman, 2000).

As described by its developers (e.g., Koehler & Mishra, 2008; Mishra & Koehler, 2006) and others (e.g., Angeli & Valanides, 2009; Kelly, 2008, 2010; Porras-Hernandez & Salinas-Amescua, 2013; Reeve, 2008), context is central to the TPACK framework. However, there is evidence teachers' context is not included in descriptions, explanations, or operationalizations - there is non-systematic inclusion - of TPACK among publications that apply the TPACK framework (Kelly, 2010). Furthermore, there is evidence for the widespread variation in meaning when context is included in descriptions of TPACK (Porras-Hernandez & Salinas-Amescua, 2013). Taken together, there is evidence the nature of the context of teachers' TPACK has been theorized in different ways and with different meanings. Viewing TPACK in light of the importance of context to recent educational research advocates for a better understanding of the context of teachers' development and enactment of TPACK.

Literature Review

In the introduction, we described the importance of context to education researchers (e.g., Alexander, Murphy, & Greene, 2011; Anderman & Anderman, 2000; Tabak, 2004; Turner & Meyer, 2000), the developers of

TPACK (e.g., Koehler & Mishra, 2008; Mishra & Koehler, 2006) and others (e.g., Angeli & Valanides, 2009; Kelly, 2008, 2010; Porras-Hernandez & Salinas-Amescua, 2013; Reeve, 2008). In this section, we identify and describe prior research about two areas of research that specifically addressed the nature of context in TPACK.

Some researchers have included context as part of the TPACK framework and subsequently described features of teachers' context, whereas many researchers did not include nor describe teachers' context. Kelly (2010) conducted a content analysis that established the extent to which context was not included among researchers' descriptions, explanations, or operationalizations of teachers' context in prior TPACK research. Kelly illustrated the non-systematic inclusion of context in prior publications about TPACK through a content analysis of 16 journal articles about TPACK. All of the articles Kelly analyzed were published between 2006 and 2009, and included TPACK as a key term. Apart from a publication by Hammond and Manfra (2009) - in which Kelly identified context was partially discussed - Kelly reported context was absent. In summary of Kelly's research, there was non-systematic inclusion of context among prior publications about TPACK.

In addition, prior research about teachers' context in prior TPACK research exhibits widespread variation in meaning for context. Salinas-Amescua and Porras-Herndandez (2013) identified this widespread variation in meaning for context, and proposed a conceptual framework to aid the process of understanding the meaning of context. Porras-Hernandez and Salinas-Amescua reviewed the literature on TPACK and discovered teachers' context was described as important, but "referred to in a rather ambiguous manner and with multiple meanings" (p. 226). Consequently, Porras-Hernandez and Salinas-Amescua argued, "it would be advisable to delve into the complexity of context knowledge more systematically in order to establish a consensus and achieve a better understanding of teacher knowledge" (p. 228). In summary of Porras-Hernandez and Salinas-Amescua's research, when context is included, there is widespread variation in its meaning.

Need for Study, Purpose, and Research Questions

There is a general need to study individuals and groups of individuals in context. Research from diverse fields has found people behave and learn differently depending upon the context (Bronfenfrenner, 1997; Cole, 1998; Greeno, 1997; Lave & Wenger, 1991; Nardi, 1996; Ross & Nisbett, 2011). Research from diverse fields has also found the incorporation of context and contextual factors into scientific research in education can make research relevant to practice (Alexander, Murphy, & Greene, 2011; Burke, 1999; Kagan, 2011; Turner & Meyer, 2010; Watt, 2010). However, context is "an abstract, nebulous concept" (Sommers, 2011, p. 34), and the incorporation of context and contextual factors into scientific research in education (e.g., Shavelson & Towne, 2004) presents conceptual and operational barriers.

There is a specific need for this study because prior research exhibits widespread variation in meaning for, and non-systematic inclusion of, context in definitions, explanations, or operationalizations of TPACK. However, this prior research exhibits limitations. Kelly's (2010) research examined a limited number of publications (n=16), and the operational definition - that is, the definition of measurable form - of context in Kelly's (2010) study was unclear. In order to attend to the need to examine a greater number of publications, we searched widely in order to accurately identify then include all appropriate publications. In order to attend to the need to be explicit about what counts as context, we used a coding frame (Table 1) based upon Porras-Hernandez & Salinas-Amescua's (2013) conceptual framework for teachers' context. Porras-Hernandez & Salinas-Amescua's (2013) research identified the widespread variation in meaning for context, but did not empirically establish this. Thus, the purpose of this study is to establish the inclusion and meaning of context in prior TPACK research, building upon prior work by 1) attending to the needs that followed Kelly's (2010) prior research, 2) attending to needs that followed Porras-Hernandez & Salinas-Amescua's (2013) prior research, and 3) examining the most recent empirical TPACK publications. The research questions for this study are:

Research Question #1 (RQ1): Has context been explicitly included when authors explain, describe, or operationalize TPACK in prior publications?
Research Question #2 (RQ2): For those publications in which context was included in authors' explanations, descriptions, or operationalizations of TPACK, what aspects of context are included?

Conceptual Framework

We adopted the conceptual framework for teachers' context and TPACK described by Porras-Hernandez and Salinas-Amescua (2013); the conceptual framework has two dimensions: scope and actors.

Porras-Hernandez and Salinas-Amescua (2013) described the differentiated and hierarchical levels - instead of context being one-dimensional - as important part of the context of teachers' TPACK. Porras-Hernandez and Salinas-Amescua's (2013) took inspiration in part from Uri Bronfenbrenner's (1997) bioecological model, which highlights the role of reciprocal interactions between individuals and "the persons, objects, and symbols" (Bronfenbrenner, 1997, p. 38) in human development, in order to argue for a conceptualization of context based around three levels, micro, meso, and macro. Porras-Hernandez and Salinas-Amescua summarized, "each of these levels comprises not only externally given conditions that influence or determine teachers' practice, but also objects of knowledge that the teacher learns to interpret" (p. 228).

Porras-Hernandez and Salinas-Amescua described the people - or actors - involved - have been described as a part of the context of teachers' TPACK. Porras-Hernandez and Salinas-Amescua (2013) also argued for a conceptualization of context based around two *actors*, teachers and students. With concern to the two actors, the authors simply indicated teachers and students are the actors "in the majority of education processes" (p. 231). This move is helpful for the same reason the author's three levels are helpful: Identifying which individuals (teachers or students) are involved in the context of teaching with technology can resolve ambiguity about who context affects - or who affects "context." The conceptual framework informed every variable of the coding frame (Table 1) except for the "Inclusion" variable.

Methods

This is a descriptive study (Shavelson & Towne, 2004). Results from this type of research can lead to theoretical developments, improved measures, and further work on cause-and-effect and mechanism of phenomena of interest (Shavelson & Towne, 2004). Specifically, this study uses mixed methods through the qualitative coding of data, and the quantitative counting of frequency. The data are all publications that meet the inclusion criteria. The type of coding we employed is qualitative content analysis (Schreier, 2012), through the use of a concept-drive coding frame, adopted from Porras-Hernandez and Salinas-Amescua.

In order to collect publications, we searched the Education Resources Information Center (ERIC) and PsychINFO databases using the keywords "technological pedagogical content knowledge," "tpack," and "tpck." We used the following inclusion criteria that each article must satisfy in order to be included as data source:

1. Article published in a peer-reviewed journal
2. Article published between 2005 and 2013
3. Article must be about TPACK. Operationally this means that "TPCK," "TPACK," or "technological pedagogical content knowledge" are included in the title, abstract (or introduction if an abstract is not included), or keywords
4. Article is empirical in nature
5. Article is published in the English language

Figure 1
Publications that met the inclusion criteria by year.

To segment the data, we identified, in a broad manner, general portions of publications that explain, describe, or operationalize TPACK. Segmenting the data will give rise to data in the manageable form needed to answer RQ1 and RQ2. To determine the specific text we added as an explanation, description, or operationalization, used *thematic criteria* - changes in topic - to determine when an explanation, description, or operationalization of TPACK begins and ends (Schreier, 2012). Explanations, descriptions, or operationalizations of TPACK may include characterizations from prior research, conditions, and other criteria. Extracted descriptions from TPACK articles then become the data that will be coded in subsequent analyses for RQ1 and RQ2. From the segmented data, coding for the inclusion (in order to provide data to answer RQ1) will be conducted first; all of the publications that included context will then be coded for the aspects of context that affect TPACK (in order to provide data to answer RQ2) will be conducted. The coding frame is summarized in Table 1; each variable is coded "0" for not included, or "1" for included.

Table 1

Coding frame for the inclusion of context and aspects of context that affect TPACK

Variable	Inclusion	Scope - Micro	Scope - Meso	Scope - Macro	Actor - Student	Actor - Teacher
Description	The term "context" as a conceptual aspect of the TPACK framework	Conditions and interactions in the classroom that affect the development, enactment, or assessment of TPACK	Conditions and interactions in the school and community that affect the development, enactment, or assessment of TPACK	Conditions and interactions at the state, national, and global level that affect the development, enactment, or assessment of TPACK	Characteristics of teachers that affect the development, enactment, or assessment of TPACK	Characteristics of students that affect the development, enactment, or assessment of TPACK

Data Analysis

The overall data analysis strategies follow the descriptive design (Shavelson & Towne, 2004). To analyze the data needed to determine whether the term context has been explicitly included when authors explain, describe, or operationalize TPACK (RQ1), we computed frequencies for the "Included" and "Not included" codes for inclusion. To analyze the data needed to determine what researchers mean by context when the term is included in explanations, descriptions, or operationalizations of TPACK, we computed frequencies for the "Included" and "Not included" codes for the variables "Scope - Micro," "Scope - Meso," "Scope - Macro," "Actors - Teacher," and "Actors - Student."

Results

There were N=193 publications which met the inclusion criteria. Of those publications, n=70 (36%) were coded "1" for inclusion. Those 70 publications were coded further for meaning. Of those publications, 84% were coded "1" for Scope - Micro, 61% were coded "1" for Scope - Meso, 14% were coded "1" for Scope - Macro, 41% were coded "1" for Actors - Student, and 57% were coded "1" for Actors - Teacher. These results are presented in Table 1.

Table 2
Results for coding for inclusion (RQ1) and meaning (RQ2)

	Inclusion of Context (RQ1)	Scope - Micro (RQ2)	Scope - Meso (RQ2)	Scope - Macro (RQ2)	Actors - Student (RQ2)	Actors - Teacher (RQ2)
# Coded "Included"/# Coded	70/193	59/70	43/70	10/70	31/70	40/70
Percentage	36%	84%	61%	14%	44%	56%

Discussion

Of the 193 publications included in this content analysis, 70 (36%) empirical studies about TPACK published in English peer-reviewed journals between 2005 and 2013 included context in descriptions, explanations, or operationalizations of TPACK. Therefore, there is non-systematic inclusion of context as regards a significant proportion of the corpus of prior work about TPACK. In this study, we extended Kelly's (2010) prior work by

examining a greater number of publications and used an operational definition of context. Through this study, the results of Kelly's prior work are thus confirmed and extended.

Of the 70 publications that included context, the aspects of context included exhibit widespread variation. These results establish a better understanding of the specific nature of the widespread variation. Through this study, Porras-Hernandez and Salinas-Amescua's (2013) argument about the widespread variation for the meaning of context is empirically established. The frequency with which publications were coded with the different codes for meaning varied from very frequent to very infrequent. 59 (84%) of publications included classroom-level interactions or conditions (e.g., Scope - Micro), so when researchers explicitly included context, researchers acknowledge and advocate for the effects of these interactions or conditions. Similarly, researchers included school- or community-level conditions or interactions (e.g., Scope - Meso) in 43 publications (61%), and characteristics of teachers (e.g., Actors - Teacher) in 40 publications (57%); both mean when researchers explicitly included context, researchers acknowledge and advocate for the effects of these interactions, conditions, and characteristics. Based upon the results of this study, these have received significant attention in the extant literature.

In contrast, researchers included national-level or global-level interactions or conditions (e.g., Scope - Macro) in 10 of publications (14%), and characteristics of students (e.g., Actors - Student) in 31 publications (44%), which means when researchers explicitly included context, researchers acknowledge and advocate for the effects of these interactions, conditions, and characteristics. Based upon the results of this study, these have received little attention in the extant literature. Taken together, the results of this study extend Kelly's (2010) and Porras-Hernandez and Salinas-Amescua's (2013) prior work, and establish a better understanding of the inclusion of context and the aspects of context present when context was included.

Limitations

This study has limitations and delimitations that warrant discussion. First, this study is limited by its reliance exclusively upon researchers' written words in publications. What researchers write may not reflect all of what researchers think about "context" in TPACK, and the use of other data sources - especially interviews - may lead to richer descriptions of "context" in TPACK. In spite of this, reliance upon researchers' written words affords examining only what researchers valued enough to publish. Second, this study is limited by coding for whether explanations, descriptions, or characterizations of TPACK explicitly contain the term context. Therefore, explanations, descriptions, or characterizations that include elements of scope and actors but do not explicitly contain the term context were not be coded. This limitation is justified because of the stated importance of context to the developers of the TPACK framework (Koehler & Mishra, 2005; Mishra & Koehler, 2006) and the importance of context articulated by educational researchers (Alexander, Murphy, & Greene, 2012; Anderman & Anderman, 2000; Barab & Plucker, 2002; Brown, Collins, & Duguid, 1989; Greeno, 1997; Sawyer, 2006; Tabak, 2004). Third, data analysis is ongoing, and reliability statistics have not yet been computed; because reliability has not yet been established, the results presented in this study may change by the conclusion of the analysis.

Significance

The relationship between context and contextual factors and the knowledge needed to teach with technology as understood through the TPACK framework is a promising area for future research. Despite multiple limitations, by establishing the inclusion and aspects of context in extant research about TPACK, this study makes a contribution to further research. First, findings with concern to which aspects of context have been represented among prior research about TPACK may contribute to recent attempts to develop contextualized measures of TPACK (e.g., Jang & Tsai, 2013). Second, arguments about non-systematic inclusion of context (e.g., Kelly, 2010) and the widespread variation in meaning for context (e.g., Porras-Hernandez & Salinas-Amescua, 2013) have stronger empirical support.

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