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Mathematical knowledge for teaching in Africa 2014–2021: A review of literature

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Background: A previous review of literature on mathematical knowledge for teaching in Africa indicated that most studies were small, qualitative studies that did not apply existing measures. The present literature review explores trends in more recent research from 2014 to 2021.

Aim: The aim of the literature review is to investigate trends in peer-reviewed journal articles on mathematical knowledge for teaching in Africa from 2014 to 2021.

Setting: A literature review of research on mathematical knowledge for teaching in Africa between 2014–2021.

Methods: After a three-step search and initial coding, 24 studies were included in the review. Studies were coded in terms of genre, type of study, research problem, sample size, instruments, level and experience of teachers, location of the study and frameworks applied.

Results: As compared with the previous literature review, there was variation in sample size, genre of the studies, as well as in the level and experience of participating teachers, and this indicates a field in positive development. Yet, there is a significant geographical lack of balance, as most studies were conducted in South Africa. In addition, there is a predominance of studies that investigate what knowledge teachers have, and many studies provide a deficit view of teachers' lack of knowledge.

Conclusion: Based on the trends in the studies reviewed, a shift in focus from teachers and their (lack of) knowledge to the knowledge demands of teaching is suggested.

Contribution: An emphasis on exploring what is involved in teaching mathematics in African contexts might provide a productive turn in research that would be of international interest and significance.

Keywords: mathematics; teaching; knowledge; research; review.

Introduction

After several decades of process-product research, Shulman (1986) identified the lack of content-focus as a 'missing paradigm' in research on teaching. By distinguishing between content knowledge, pedagogical content knowledge and curriculum knowledge, he suggested that there are several types of knowledge of content that are important for teaching. Following Shulman, a continually growing body of research has investigated various aspects of content knowledge for teaching. In mathematics education, we often refer to this as mathematical knowledge for teaching. Although this term is often used with reference to the framework by Ball, Thames and Phelps (2008), arguably among the most commonly used frameworks in this field of research, it is used as a more generic term in this review of literature – broadly referencing mathematical knowledge that is relevant for teaching.

Research on mathematical knowledge for teaching is flourishing, and the fact that a key publication like that of Ball et al. (2008) has over 9000 citations, at the time of writing, testifies to this. In their review of research on mathematical knowledge for teaching, Hoover et al. (2016) analysed 190 journal articles that were published on this topic between 2006 and 2013. Most of those articles were from North America, Asia and Europe, and only seven articles in that review were from Africa. In an examination of the African subset of research on mathematical knowledge for teaching, Jakobsen and Mosvold (2015) suggested that more research was needed, in particular on the primary level and among pre-service teachers. They also noticed that few studies used standardised measures, and they suggested that more studies of mathematical knowledge for teaching in Africa should use the existing measures. Based on these previous reviews, the present study reviews more recent research on mathematical knowledge for teaching in Africa, focusing on research that has been published between 2014 and 2021. The following research question is approached:

> What characterises research on mathematical knowledge for teaching in Africa from 2014 to 2021?

Previous studies

To provide some more context, the present section briefly describes some main tendencies in previous research on mathematical knowledge for teaching in Africa. In their review of African studies of mathematical knowledge for teaching between 2006 and 2013, Jakobsen and Mosvold (2015) noticed that most studies were small-scale qualitative studies – only one study was large-scale and applied quantitative methods – and none of the studies used the existing measures of mathematical knowledge for teaching. Five of the studies were from South Africa, whereas one study was from Mozambique, and one study involved teachers from Botswana and South Africa. Four studies reported from the same large project (the QUANTUM project) of middle school and secondary school mathematics teachers in South Africa.

Three studies – all from the QUANTUM project – explored the nature of mathematical knowledge for teaching. One of these studies elaborated on what is involved in unpacking the mathematical work of teaching (Adler & Davis 2006). In another study, Adler (2010) discussed two interrelated tasks of teaching to develop an argument that the design and mediation of tasks are particularly important aspects of mathematical knowledge for teaching. In the third study, Kazima, Pillay and Adler (2008) argued that mathematical knowledge for teaching is related to the content being taught, and they explored the tasks of defining, explaining, representing, working with students' ideas, restructuring tasks and questioning.

Two other studies investigated what teachers know and how their knowledge influenced practice. In a large-scale study, Sapire and Sorto (2012) explored how mathematical knowledge for teaching influenced the quality of mathematics teaching among teachers in Botswana and South Africa. They concluded that teachers were lacking in pedagogical content knowledge, and they mainly applied tasks of low-cognitive level in their teaching. In another study, Bansilal (2012) explored how the poor content knowledge of an experienced teacher influenced her teaching.

In addition, two studies in the review of Jakobsen and Mosvold (2015) attended to the influence of teacher education (TE) and professional development (PD) on mathematical knowledge for teaching. Pournara (2009) explored how spreadsheets, as introduced in a course in financial mathematics for South African pre-service teachers, could positively influence the work of teaching mathematics. Finally, in yet another article from the QUANTUM project, Huillet, Adler and Berger (2011) reported on how a PD project such as this might influence the development of mathematical knowledge for teaching.

In summary, studies on mathematical knowledge for teaching in Africa – from 2006 to 2013 – were relatively few. The studies were mostly small-scale, qualitative studies, and they did not use the existing measures of mathematical knowledge for teaching. This literature review seeks to explore the trends in more recent research in this area.

Methods

The present review builds on the approach of the previous review of literature on mathematical knowledge for teaching by Hoover et al. (2016), which investigated literature between 2006 and 2013, and on the review of the African subset of literature in that review (Jakobsen & Mosvold 2015). An elaboration of the choices that were made concerning search and inclusion of literature, coding of articles and analysis of results are discussed next.

Search and inclusion

The search for articles was conducted in three stages. Firstly, a broad search was conducted in the Eric database for peer-reviewed journal articles that included the search terms 'mathematical knowledge for teaching' and 'Africa'. This search only gave nine results, indicating that the search terms might have been too narrow. Secondly, a more extensive search was conducted in Eric for peer-reviewed journal articles in English that were published between 2014 and 2021. Search terms were 'mathematics AND knowledge AND teaching' in the abstract, with Africa as a location identifier. This search gave 79 articles. To avoid missing important studies, manual searches were conducted in the archives of two prominent African journals in mathematics education: *African Journal of Mathematics, Science and Technology Education* (*AJRMSTE*) and *Pythagoras*. These manual searches gave 15 hits in *AJRMSTE*, 10 of which were published between 2014 and 2021. The search in *Pythagoras* gave 31 hits.

Bibliographic information was collected for the search results from all three search phases and duplicates were removed. The result was 86 articles for potential inclusion in the review. The abstracts of these articles were then coded, in order to decide if the study was (1) an empirical study, (2) investigated mathematical knowledge for teaching – broadly interpreted, and (3) that the study was from Africa. Some articles were excluded in this phase because they were theoretical articles (e.g. Askew 2020) and some were excluded because they were reviews of previous research and not empirical studies themselves (e.g. Adler et al. 2017). Most studies were excluded because they were not about mathematical knowledge for teaching. After this initial coding phase, 30 studies remained and were coded in full. Seven additional articles were excluded in this phase, as they turned out to not have a main emphasis on mathematical knowledge for teaching after all, and the final number of studies that were included in the review was thus $N = 24$.

Coding

Based on a slightly adjusted coding manual from the previous review of Hoover et al. (2016), the articles were coded in terms of the following categories with example codes where relevant:

- Genre of study
  - *nat* (nature of knowledge)
  - *dev* (development of knowledge)
  - *inf* (influence of knowledge on other variables)
  - *oth* (other focus, e.g. what knowledge teachers have)
- Causal design of the studies
  - *not*
  - *qal* (primarily qualitative analysis)
  - *sta* (primarily statistical analysis)
  - *qsi* (quasi-experimental design)
- Underlying problem that motivated studies
- Sample size
- Instruments that were used to study mathematical knowledge for teaching
- Level of teachers or settings that were studied
  - *prm* (primary or K–8)
  - *mid* (middle grades, 5–9)
  - *sec* (secondary or 7–13, other than middle)
  - *ter* (tertiary or post-secondary)
  - *all* (broader or no particular group identified)
- Stage or experience of teachers
  - *not* (not yet in TE)
  - *fut* (future, prospective or pre-service)
  - *beg* (beginning teachers, 1–3 years of experience)
  - *exp* (experienced teachers)
  - *prc* (practising teachers)
  - *bth* (both pre-service and in-service teachers in focus)
- What country the study was conducted in
- Lessons learned

In addition, the number of citations for each article was also recorded, to get an indication about the impact of each study.

As an example, to illustrate the coding, the study by De Freitas and Spangenberg (2019) was coded to be primarily about investigating the construct of mathematical knowledge for teaching (nature). It primarily used statistical data to show causality, and the underlying problem was coded to be *What relationships?* In other words, the underlying problem emphasised the relationships between different aspects of mathematical knowledge for teaching. This was a large-scale study ($n = 93$), and it applied the TPACK instrument to investigate mathematical knowledge for teaching among teachers in Grades 7–9 (*mid*) and the participants were practising teachers (*prc*). The study was conducted in South Africa, and the article had 19 citations in Google Scholar at the time of coding. The number of citations was relatively high (fourth overall), in particular when considering that the publication year was as recent as 2019. Based on their analysis, the authors argued that attending to teachers' levels of TPACK is important for continuous PD, and this was considered to be the main lesson learned from the study.

Analysis

Based on the coding of each article, frequencies of codes were generated to further explore patterns across the studies. An additional round of analysis was conducted concerning the instrument of studies because the initial coding indicated that few studies applied use of standardised measures with scores. Descriptive codes of the methods of study were developed inductively to provide a more meaningful overview of how the studies investigated mathematical knowledge for teaching. Through this phase of inductive coding, the theoretical or analytic frameworks that were applied in the studies were also considered. These last two aspects of the analysis deviated from the previous review of Hoover et al. (2016), but they were considered relevant for this review.

To increase trustworthiness and transparency – and to provide a resource for other researchers – the entire process of this literature review has been extensively documented and all source files are available in a public Github repository.

Ethical considerations

This article followed all ethical standards for research without direct contact with human or animal subjects.

Results and discussion

This section presents results from the review of research on mathematical knowledge for teaching in Africa (2014–2021) and discusses how the results differ from the previous reviews. After an initial consideration of where the studies are from, subsections follow that explore the focus of studies, methods used and frameworks applied.

In the previous review by Jakobsen and Mosvold (2015), five out of seven articles on mathematical knowledge for teaching were from South Africa. The present review includes 24 studies, and the overwhelming majority of studies were conducted in South Africa (21 out of 24 studies). Two studies were conducted in Malawi and one was from Lesotho. This indicates that research on mathematical knowledge for teaching has continued to flourish in South Africa, but – with a few notable exceptions – there is not much research on this topic elsewhere in Africa.

Focus and contribution of studies

There are different approaches to describe the focus of a research study. This review considers the genre of the study and the underlying problem of the study. The latter does not refer to the research question as formulated by the authors, but rather to a more general notion of what is interpreted to be the underlying problem of the study.

While considering the genre of study, it can be observed that almost half of the studies (n = 10) were coded as *other*, which in these cases indicated that they focused on evaluating teachers' knowledge. The underlying problem in these studies was *What teachers know?* This tendency is interesting in comparison to what Hoover et al. (2016) found in their review of research on mathematical knowledge for teaching globally. Only 11% of the studies in that review focused on what teachers know, whereas almost half of the studies had a focus on development of mathematical knowledge for teaching and 28.9% had a focus on the nature of this knowledge.

While considering the underlying problem approached, it can be noticed that almost half of the studies focused on *what teachers know* (n = 10), and these studies tended to report on insufficient knowledge among teachers. A selection of studies focused on how TE or PD might influence mathematical knowledge for teaching (n = 4 and n = 2). Among the four studies on the nature of mathematical knowledge for teaching, two had a focus on relationships between different aspects of knowledge, and two explored what mathematical knowledge for teaching is. Only one study investigated how mathematical knowledge contributes to student learning (Pournara et al. 2015), one study focused on its contribution to practice (Spangenberg 2021) and only one study explored how mathematical knowledge for teaching develops (Venkat 2015). In the next section, we consider the problem of studies in relation to the overall methods applied.

It is not easy to provide a short and accurate description of the main contributions of a study, and the brief descriptions in Table 1 only provide a simplified representation. Still, it is worth observing that almost half of the studies (n = 11) seem to tell a story about teachers' lack of knowledge. Some studies indicate that teachers lack even foundational understanding of mathematics, whereas other studies identify a lack of deep understanding of the mathematical content. It was also noticed how a couple of studies argue that lesson study might positively influence mathematical knowledge for teaching (Helmbold et al. 2021; Jita & Ige 2019). Results from the studies seem to imply that development of mathematical knowledge for teaching is possible (Venkat 2015), but supporting this development can be a complex and involved work (Mwadzaangati & Kazima 2019). One study reported that mentors can hinder knowledge development (Msimango et al. 2020), whereas another study indicated that mentors can positively influence development of teachers' knowledge – even if there are tensions between mentors and mentees (Sibanda & Amin 2021). Yet another study provided interesting indications about how particular tasks that are carefully connected with practice might positively influence development of mathematical knowledge for teaching (Siyepu & Vimbelo 2021). The two studies about influence of knowledge indicate that teachers' knowledge can influence students' learning as well as practice (Pournara et al. 2015; Spangenberg 2021).

TABLE 1: Focus, genre and contribution of studies.

No.	Citation	Country	Genre	Problem	Lesson
1	Alex (2019)	RSA	*oth*	What teachers know?	Lack of knowledge
2	Bansilal, Brijlall and Mkhwanazi (2014)	RSA	*oth*	What teachers know?	Lack of knowledge
3	Bowie, Venkat and Askew (2019)	RSA	*oth*	What teachers know?	Lack of knowledge
4	Chikiwa, Westaway and Graven (2019)	RSA	*nat*	What relationships?	KCT is foundational
5	De Freitas and Spangenberg (2019)	RSA	*nat*	What relationships?	Attending to aspects of knowledge important
6	Feza (2016)	RSA	*oth*	What teachers know?	Lack of knowledge
7	Feza (2018)	RSA	*dev*	What PD?	Lack of knowledge
8	Fonseca and Petersen (2015)	RSA	*dev*	What PD?	Lack of knowledge
9	Fonseca (2021)	RSA	*dev*	What TE?	Attending to aspects of knowledge important
10	Helmbold, Venketsamy and Van Heerden (2021)	RSA	*dev*	What PD?	LS influenced knowledge
11	Jacinto and Jakobsen (2020)	MAW	*oth*	What teachers know?	PSTs emphasise particular knowledge
12	Jita and Ige (2019)	RSA	*dev*	What PD?	LS influenced knowledge
13	Kalobo (2016)	RSA	*oth*	What teachers know?	Lack of knowledge
14	Makonye (2020)	RSA	*nat*	What is MKT?	Lack of knowledge
15	Msimango, Fonseca and Petersen (2020)	RSA	*dev*	What TE?	Mentors can hinder knowledge development
16	Mwadzaangati and Kazima (2019)	MAW	*nat*	What is MKT?	Supporting knowledge development is complex
17	Pournara et al. (2015)	RSA	*inf*	Contribute to student learning?	MKT influences student learning
18	Setoromo, Bansilal and James (2018)	LES	*oth*	What teachers know?	Lack of knowledge
19	Sibanda and Amin (2021)	RSA	*dev*	What PD?	Mentors can influence knowledge development
20	Siyepu and Vimbelo (2021)	RSA	*oth*	What teachers know?	Tasks can influence knowledge development
21	Spangenberg (2021)	RSA	*inf*	What contributes to practice	PCK influences practice
22	Ubah and Bansilal (2018)	RSA	*oth*	What teachers know?	Lack of knowledge
23	Venkat (2015)	RSA	*dev*	How MKT develops?	Development is possible
24	Vermeulen and Meyer (2017)	RSA	*oth*	What teachers know?	Lack of knowledge

PD, professional development; TE, teacher education.

TABLE 2: Overview of methods in studies.

Study	*N*	Design	Level	Teachers	Problem	Instrument
Alex (2019)	40	*sta*	*all*	*fut*	What teachers know?	National mathematics examination
Bansilal et al. (2014)	253	*sta*	*sec*	*prc*	What teachers know?	National mathematics examination (adjusted)
Bowie et al. (2019)	770	*sta*	*prm*	*fut*	What teachers know?	Mathematics content test
Feza (2016)	17	*qal*	*prm*	*prc*	What teachers know?	Scenario-based questionnaire
Jacinto and Jakobsen (2020)	6	*qal*	*prm*	*fut*	What teachers know?	Questionnaire (self-report)
Kalobo (2016)	66	*sta*	*sec*	*prc*	What teachers know?	Questionnaire (perceptions)
Setoromo et al. (2018)	48	*sta*	*prm*	*prc*	What teachers know?	Questionnaire (test)
Siyepu and Vimbelo (2021)	30	*qal*	*all*	*fut*	What teachers know?	Mathematics content test
Ubah and Bansilal (2018)	60	*qal*	*prm*	*fut*	What teachers know?	Interviews
Vermeulen and Meyer (2017)	3	*qal*	*prm*	*prc*	What teachers know?	Mathematics content test
Feza (2018)	14	*qal*	*prm*	*prc*	What PD?	COEMET
Fonseca and Petersen (2015)	108	*sta*	*mid*	*fut*	What PD?	Mathematics content test
Helmbold et al. (2021)	6	*qal*	*prm*	*prc*	What PD?	Questionnaire (self-report)
Jita and Ige (2019)	125	*qal*	*all*	*prc*	What PD?	Portfolio (self-report)
Fonseca (2021)	62	*qal*	*prm*	*fut*	What TE?	Self-report
Msimango et al. (2020)	12	*qal*	*prm*	*fut*	What TE?	Interviews (self-report)
Chikiwa et al. (2019)	1	*qal*	*prm*	*exp*	What relationships?	None
De Freitas and Spangenberg (2019)	93	*sta*	*mid*	*prc*	What relationships?	TPACK
Makonye (2020)	20	*qal*	*ter*	*exp*	What is MKT?	Questionnaire and interview (test)
Mwadzaangati and Kazima (2019)	2	*qal*	*sec*	*exp*	What is MKT?	Observation and interview
Pournara et al. (2015)	21	*sta*	*sec*	*prc*	Contribute to student learning?	Math test (for learners)
Spangenberg (2021)	12	*qal*	*sec*	*prc*	What contributes to practice	Observation, interview, documentation
Venkat (2015)	1	*qal*	*prm*	*prc*	How MKT develops?	Observation and Interview

PD, professional development; TE, teacher education.

Methods

Table 2 provides an overview of key codes concerning methods of studies, sorted by the underlying problem. Among the studies of what teachers know, most included some kind of mathematics content test. A couple used national mathematics certificate test for teachers (Alex 2019; Bansilal et al. 2014), but many developed their own tests, often based on the existing measures or frameworks (Bowie et al. 2019). Whereas many instruments had a primary focus on common knowledge of mathematical content, a few included some kind of scenario or teaching context (Feza 2016). Although most studies in this category involved some kind of content test, there was one study that included a self-report questionnaire (Jacinto & Jakobsen 2020), and one that involved a questionnaire that focused on participants' perceptions (Kalobo 2016).

Six studies explored what or how PD or TE influence mathematical knowledge for teaching. Most of these studies involved some kind of self-report, either through interviews (Msimango et al. 2020), questionnaires (Helmbold et al. 2021), portfolios (Jita & Ige 2019) or self-report journals (Fonseca 2021). One study applied a standardised observation protocol (COEMET) to assess practice (Feza 2018) and one study used a mathematics content test (Fonseca & Petersen 2015).

The two studies that explored what mathematical knowledge for teaching is (*What is MKT?*) both used a combination of interviews with questionnaires or observations (Makonye 2020; Mwadzaangati & Kazima 2019). Among the two studies that investigated relationships between different aspects of knowledge, one of these used a standardised TPACK instrument (De Freitas & Spangenberg 2019). A study of what contributes to student learning used mathematics learner tests (Pournara et al. 2015), a study of what contributes to practice used a combination of observations, interviews and other documentation such as lesson plans (Spangenberg 2021), whereas a study of how mathematical knowledge for teaching develops used a combination of observations of interviews (Venkat 2015).

TABLE 3: Primary and secondary framework in studies.

Frameworks	Primary	Secondary
MKT	8	7
PCK	1	11
COACTIV	1	2
APOS	2	-
TEDS-M	-	2
TPACK	1	-

MKT, Mathematical Knowledge for Teaching; PCK, Pedagogical Content Knowledge; COACTIV, Cognitive Activation; APOS, Actions, Process, Objects, Schema; TEDS-M: Teacher Education and Development Study in Mathematics; TPACK, Technology Pedagogy And Content Knowledge.

Frameworks applied

After having completed coding, the author decided to consider what theoretical or conceptual frameworks were applied in these studies. Some articles had a clear framework, whereas others did not. Typically, an article with a clear framework would specify a primary (and possibly secondary) framework or theoretical grounding of how they consider mathematical knowledge for teaching in the study. Articles with no clear framework do not specify a primary framework for understanding mathematical knowledge for teaching, but they might mention some frameworks without specifying that these were frameworks applied in the study. In summary, 13 out of the 24 studies were specific about their theoretical framework, whereas 10 did not have a clear framework or were unclear about how they conceptualised mathematical knowledge for teaching. Table 3 provides an overview of the most common primary and secondary theoretical frameworks in the studies reviewed.

In other words, a majority of studies in this literature review had the MKT framework of Ball et al. (2008) as their primary or secondary framework. Only one study had PCK as a theoretical framework (Msimango et al. 2020) and they used the *Clearly* PCK framework by Chick et al. (2006), but almost half of the studies emphasised the conceptualisation of PCK (mostly with reference to Shulman). Almost all of the studies that had MKT as a primary framework emphasised its connections with Shulman's (1986) conception of PCK. One study had COACTIV as their primary theoretical framework (Makonye 2020), whereas two referred to this. Two studies applied the APOS theory as their primary theoretical framework (Bansilal et al. 2014; Ubah & Bansilal 2018), whereas one used TPACK as their primary framework (De Freitas & Spangenberg 2019). Two studies gave prominence to the TEDS-M framework, but none of the studies in this review used it as a primary framework.

Concluding discussion

Research on mathematical knowledge for teaching appears to be expanding in the African context. Whereas a previous review of literature between 2006 and 2013 included seven studies, this review of literature from the period between 2014 and 2021 included 24 studies. However, it should be observed that the overwhelming majority of studies were from South Africa, and it would have been interesting to see the outcome from studies of mathematical knowledge for teaching in other African countries. The concluding discussion will highlight three observations from the present review of literature.

The first observation is about the main focus of the studies. It is interesting to notice how studies of mathematical knowledge for teaching in Africa have a strong emphasis on evaluating what teachers know. This was much less prevalent in the review of international review by Hoover et al. (2016) and one might wonder why there is such a significant difference in the emphasis of studies in Africa as compared with the rest of the world. Of course, several studies have reported on the low performance of African learners in mathematics and comparing this with what appears to be an overall lack of knowledge among African mathematics teachers might be natural. As an outside observer, this seemingly strong emphasis on the lack of knowledge makes me wonder if there might be other and possibly more productive approaches to studying mathematical knowledge for teaching in Africa. Two decades ago, Ball, Lubienski and Mewborn (2001) called for a shift from considering teachers and their mathematical knowledge towards mathematical knowledge in and for teaching. The latter involves studying teaching and considering the knowledge demands that are entailed in teaching, as opposed to considering teachers and the knowledge they have (or lack). Perhaps such a shift in focus might also be productive in the African context.

A second observation concerns the frameworks applied. It is not surprising that many studies reference the MKT framework of Ball et al. (2008), because this is arguably the most referenced and applied framework on mathematical knowledge for teaching in our field. It is perhaps more surprising that so many studies are unclear about how they conceptualise mathematical knowledge for teaching. Perhaps there is a hidden assumption that everyone knows what mathematical knowledge for teaching is and agrees about how it is understood. If this is the case, I would warn against such an assumption. Some studies within this field focus on what knowledge teachers have, others emphasise the knowledge teachers use in their teaching, and yet others consider the knowledge demands that are entailed in teaching. Many seem to consider knowledge as cognitive, refer to *teachers' knowledge* and think about the knowledge as some kind of mental object or resource that teachers might possess to smaller or larger extent. Others consider *teaching knowledge* or *knowledge for teaching*, and they consider knowledge as entailed by practice and not as cognitive; consider for instance how Ball et al. (2008) refer to their theory of mathematical knowledge for teaching as *practice based*. It is important to distinguish between the underlying problems of the studies in this field, but it is also crucially important to carefully distinguish between different ways in which mathematical knowledge for teaching is conceptualised. Everyone that references Shulman (1986) does not consider knowledge in the same way.

The third and final observation is related to the instruments applied in studies. Hoover et al. (2016) emphasised the promise of developing and using measures of mathematical knowledge for teaching, and Jakobsen and Mosvold (2015) called for more use of existing measures in their review of research on mathematical knowledge for teaching in Africa between 2006 and 2013. Although many recent African studies do involve some kind of mathematics content tests, it is interesting to observe that almost no studies use standardised measures of *mathematical knowledge for teaching*. For instance, although many refer to the MKT framework (Ball et al. 2008), none of the African studies in this review applied their measures. There are some examples of studies that have explored use of measures in African contexts (Cole 2011), and there are also examples of similar research that has escaped the search in this literature review – the study by Kazima, Jakobsen and Kasoka (2016) is a notable example – and much can be learned from such attempts. For instance, one might learn that many core demands of teaching are similar across cultural contexts, even though many other aspects of teaching and classrooms differ. This implies that a potentially productive line of research in the African context might be to explore the mathematical tasks of teaching that can be identified in African contexts and consider their entailed mathematical demands, very much like Professor Mercy Kazima emphasised and illustrated in her plenary lecture at the 14th International Congress on Mathematical Education (ICME-14).

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Data availability

All data are available at https://github.com/rmosvold/mkt-africa.

Disclaimer

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References

Adler, J., 2010, 'Mathematics for teaching matters', *Education as Change* 14(2), 123–135. https://doi.org/10.1080/16823206.2010.518000

Adler, J., Alshwaikh, J., Essack, R. & Gcsamba, L., 2017, 'Mathematics education research in South Africa 2007–2015: Review and reflection', *African Journal of Research in Mathematics, Science and Technology Education* 21(1), 1–14. https://doi.org/10.1080/18117295.2016.1265858

Adler, J. & Davis, Z., 2006, 'Opening another black box: Researching mathematics for teaching in mathematics teacher education', *Journal for Research in Mathematics Education* 37(4), 270–296.

Alex, J.K., 2019, 'The preparation of secondary school mathematics teachers in South Africa: Prospective teachers' student level disciplinary content knowledge', *Eurasia Journal of Mathematics, Science and Technology Education* 15(12), em1791. https://doi.org/10.29333/ejmste/105782

Askew, M., 2020, 'Identifying effective mathematics teaching: Some questions for research', *African Journal of Research in Mathematics, Science and Technology Education* 24(1), 1–9.https://doi.org/10.1080/18117295.2019.1710049

Ball, D.L., Lubienski, S.T. & Mewborn, D.S., 2001, 'Research on teaching mathematics: The unsolved problem of teachers' mathematical knowledge,' in V. Richardson (ed.), *Handbook of research on teaching*, vol. 4, pp. 433–456, American Educational Research Association, Washington, DC.

Ball, D.L., Thames, M.H. & Phelps, G., 2008, 'Content knowledge for teaching: What makes it special', *Journal of Teacher Education* 59(5), 389–407. https://doi.org/10.1177/0022487108324554

Bansilal, S., 2012, 'Arriving at the starting point? Exploring a teacher's use of circular reasoning in a mathematics classroom', *Education as Change* 16(1), 35–49. https://doi.org/10.1080/16823206.2012.691706

Bansilal, S., Brijlall, D. & Mkhwanazi, T., 2014, 'An exploration of the common content knowledge of high school mathematics teachers', *Perspectives in Education* 32(1), 30–46.

Bowie, L., Venkat, H. & Askew, M., 2019, 'Pre-service primary teachers' mathematical content knowledge: An exploratory study', *African Journal of Research in Mathematics, Science and Technology Education* 23(3), 286–297. https://doi.org/10.1080/18117295.2019.1682777

Chick, H.L., Baker, M., Pham, T. & Cheng, H., 2006, 'Aspects of teachers' pedagogical content knowledge for decimals', in J. Novotna, H. Moraova, M. Kraka & N. Stehlikova (eds.), *Proceedings of the 30th Conference of the International Group for the Psychology of Mathematics Education*, vol. 2, pp. 297–304, Prague, PME.

Chikiwa, S., Westaway, L. & Graven, M., 2019, 'What mathematics knowledge for teaching is used by a grade 2 teacher when teaching counting', *South African Journal of Childhood Education* 9(1), a567. https://doi.org/10.4102/sajce.v9i1.567

Cole, Y.A., 2011, 'Mathematical knowledge for teaching: Exploring its transferability and measurement in Ghana', PhD thesis, University of Michigan.

De Freitas, G. & Spangenberg, E.D., 2019, 'Mathematics teachers' levels of technological pedagogical content knowledge and information and communication technology integration barriers', *Pythagoras* 40(1), a431. https://doi.org/10.4102/pythagoras.v40i1.431

Feza, N.N., 2016, 'Teaching 5- and 6-year-olds to count: Knowledge of South African educators', *Early Childhood Education Journal* 44(5), 483–489. https://doi.org/10.1007/s10643-015-0736-z

Feza, N.N., 2018, 'Teachers' journeys: A case of teachers of learners aged five to six', *Africa Education Review* 15(1), 72–84. https://doi.org/10.1080/18146627.2016.1241673

Fonseca, K., 2021, 'Self-reported mathematical problem-solving skills of future mathematics teachers', *South African Journal of Childhood Education* 11(1), a1011. https://doi.org/10.4102/sajce.v11i1.1011

Fonseca, K. & Petersen, N., 2015, 'Online supplementary mathematics tuition in a first-year childhood teacher education programme', *South African Journal of Childhood Education* 5(3), a375. https://doi.org/10.4102/sajce.v5i3.375

Helmbold, E., Venketsamy, R. & Van Heerden, J., 2021, 'Implementing lesson study as a professional development approach for early grade teachers: A South African case study', *Perspectives in Education* 39(3), 183–196. https://doi.org/10.18820/2519593X/pie.v39.i3.14

Hoover, M., Mosvold, R., Ball, D.L. & Lai, Y., 2016, 'Making progress on mathematical knowledge for teaching', *The Mathematics Enthusiast* 13(1), 3–34. https://doi.org/10.54870/1551-3440.1363

Huillet, D., Adler, J. & Berger, M., 2011, 'Teachers as researchers: Placing mathematics at the core', *Education as Change* 15(1), 17–32. https://doi.org/10.1080/16823206.2011.580769

Jacinto, E.L. & Jakobsen, A., 2020, 'Mathematical knowledge for teaching: How do primary pre-service teachers in Malawi understand it?', *African Journal of Research in Mathematics, Science and Technology Education* 24(1), 31–40. https://doi.org/10.1080/18117295.2020.1735673

Jakobsen, A. & Mosvold, R., 2015, 'Mathematical knowledge for teaching in Africa – A review of empirical research', D. Huillet (ed.), *Mathematics, science and technology education for empowerment and equity: Final proceedings*, pp. 115–124, Southern African Association for Research in Mathematics, Science and Technology Education, Maputo.

Jita, L.C. & Ige, O.A., 2019, 'South African teachers' mathematical knowledge: Reflections from short learning intervention programme (slip)', *Problems of Education in the 21st Century* 77(6), 705–721. https://doi.org/10.33225/pec/19.77.705

Kalobo, L., 2016, 'Teachers' perceptions of learners' proficiency in statistical literacy, reasoning and thinking', *African Journal of Research in Mathematics, Science and Technology Education* 20(3), 225–233. https://doi.org/10.1080/18117295.2016.1215965

Kazima, M., Jakobsen, A. & Kasoka, D.N., 2016, 'Use of mathematical tasks of teaching and the corresponding LMT measures in the Malawi context', *The Mathematics Enthusiast* 13(1), 171–186. https://doi.org/10.54870/1551-3440.1371

Kazima, M., Pillay, V. & Adler, J., 2008, 'Mathematics for teaching: Observations from two case studies', *South African Journal of Education* 28(2), 283–299. https://doi.org/10.15700/saje.v28n2a168

Makonye, J.P., 2020, 'Towards a culturally embedded financial mathematics PCK framework', *Research in Mathematics Education* 22(2), 98–116. https://doi.org/10.1080/14794802.2020.1752788

Msimango, M.N., Fonseca, K. & Petersen, N.F., 2020, 'Mentoring and preparing primary school mathematics teachers', *Perspectives in Education* 38(2), 272–284. https://doi.org/10.18820/2519593X/pie.v38.i2.18

Mwadzaangati, L. & Kazima, M., 2019, 'An Exploration of teaching for understanding the problem for geometric proof development: The case of two secondary school mathematics teachers', *African Journal of Research in Mathematics, Science and Technology Education* 23(3), 298–308. https://doi.org/10.1080/18117295.2019.1685221

Pournara, C., 2009, 'Spreadsheets as a transparent resource for learning the mathematics of annuities', *For the Learning of Mathematics* 29(3), 49–52. https://doi.org/10.15700/saje.v35n3a1083

Pournara, C., Hodgen, J., Adler, J. & Pillay, V., 2015, 'Can improving teachers' knowledge of mathematics lead to gains in learners' attainment in mathematics?', *South African Journal of Education* 35(3), 1083. https://doi.org/10.15700/saje.v35n3a1083

Sapire, I. & Sorto, M.A., 2012, 'Analyzing teaching quality in Botswana and South Africa', *Prospects* 42(4), 433–451. https://doi.org/10.1007/s11125-012-9250-x

Setoromo, M., Bansilal, S. & James, A., 2018, 'Lesotho Grade R teachers' mathematical knowledge for teaching numeracy', *South African Journal of Childhood Education* 8(2), a585. https://doi.org/10.4102/sajce.v8i2.585

Shulman, L.S., 1986, 'Those who understand: Knowledge growth in teaching', *Educational Researcher* 15(2), 4–14. https://doi.org/10.3102/0013189X015002004

Sibanda, D. & Amin, N., 2021, 'The link between a mentorship programme for mathematics, science, and technology in-service teachers and professional development', *Sage Open* 11(1), 1–9. https://doi.org/10.1177/2158244020988732

Siyepu, S.W. & Vimbelo, S.W., 2021, 'Pre-service teachers' mathematical engagement in learning about the total surface areas of geometrical solids', *South African Journal of Education* 41(2), 1837. https://doi.org/10.15700/saje.v41n2a1837

Spangenberg, E.D., 2021, 'Manifesting of pedagogical content knowledge on trigonometry in teachers' practice', *Journal of Pedagogical Research* 5(3), 135–163. https://doi.org/10.33902/JPR.2021371325

Ubah, I.J.A. & Bansilal, S., 2018, 'Pre-service primary mathematics teachers' understanding of fractions: An action-process-object-schema perspective', *South African Journal of Childhood Education* 8(2), a539. https://doi.org/10.4102/sajce.v8i2.539

Venkat, H., 2015, 'Mathematical practices and mathematical modes of enquiry: Same or different?', *International Journal of Stem Education* 2, 6. https://doi.org/10.1186/s40594-015-0018-8

Vermeulen, C. & Meyer, B., 2017, 'The equal sign: Teachers' knowledge and students' misconceptions', *African Journal of Research in Mathematics, Science and Technology Education* 21(2), 136–147. https://doi.org/10.1080/18117295.2017.1321343