responsive pedagogy, tiered instruction and on and on. This jargon, however, is often ill-defined, and its use masks considerable differences in underlying assumptions and visions. Although we all were using similar terms when describing launches (*e.g.,* we all agreed that we should not reduce the cognitive demand, we should support students in making sense of the problem) we had vastly different pictures of what those words meant in practice. Furthermore, we did not have a technical language that described typical student experiences in launches, common pedagogical challenges, or specific moves that teachers might make.

Conclusion

In retrospect, given the diversity and complexity of classrooms and classroom teaching, it is not surprising that we viewed the same launch differently. Divergent views on launches suggest the need for a larger framework describing:

> the most common obstacles students face when initially confronted with a particular demanding task
>
> factors that bring these obstacles to the fore
>
> moves that support students as they overcome those obstacles

Clearly, such a framework could not be perfect. It would not be able to account for all the complexity involved in launching. However, teachers know that all of their work is contingent; it is the best they can do at any given moment with the tools that they have. Professional judgment cannot be replaced by a formula, recipe, or someone's abstract definition of best practice. However, this framework might introduce a technical language that will enable teachers to plan, revise and improve their practice together. And it makes it less likely for us, once again, to fall prey to the obvious, hiding in plain sight.

Notes

[1] When interviewing Gloriana González and Jennifer Eli in Math Ed Podcast Episode 1512. Online at http://www.podomatic.com/podcasts/mathed/episodes/2015-06-24T07_53_50-07_00

[2] In the video "Joel Spengler introduces the context", Best Buys, Ratios and Rates: Developing the Context (New Perspectives Online) at https://www.newperspectivesonline.net.

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What is worth publishing? A response to Niss

ARTHUR BAKKER

Let me first thank Mogens Niss for initiating an important discussion about the nature of mathematics education research. It is important to reflect regularly on our own discipline, including its publishing practices, in particular when these practices may prevent valuable work from getting published in the main journals in our field. In this response, I first offer some general reflections before I respond as editor-in-chief of *Educational Studies in Mathematics* (ESM)—one of the journals mentioned explicitly by Niss.

Reflections on the concerns

The essence of Niss' (2018, 2019) concern, as I interpret it, is that form may have become more important than content. Articles with a particular structure—that of the classical empirical study—may indeed have become easier to publish than nonstandard ones which still communicate worthwhile content, such as conceptual, theoretical, or position papers. This form versus content issue reminds me of a controversy between Hilbert and Frege on symbolization. Frege acknowledged the importance of symbolization, emphasized by Hilbert, but also warned that progress could be stopped or delayed if formalism became too important. In a letter to Hilbert, Frege wrote:

> Ich möchte dieses [Symbolisieren] mit dem Verholzungsvorgange vergleichen. Wo der Baum lebt und wächst, muss er weich und saftig sein. Wenn aber das Saftige nicht mit der Zeit verholzte, könnte keine bedeutende Höhe erreicht werden. Wenn dagegen alles Grüne verholzt ist, hört das Wachstum auf.
>
> I would like to compare this [process of symbolizing] with lignification [transformation into wood]. Where the tree lives and grows, it must be soft and sappy. If, however, the sappiness does not lignify, the tree cannot grow higher. If, on the contrary, all the green of the tree transforms into wood, the growing stops. (Frege, 1895/1976, p. 59; my translation)

Transposing this metaphor to research, I interpret new and fruitful ideas to be the green living power, which needs some form to grow. With Frege, one may conclude that lignification is required in the development of any discipline, but there is also a risk that progress is hindered by form conventions. This is a genuine concern: In a recent analysis of the history of psychology since 1950, Flis (2018) came to the

dramatic conclusion that there has been little progress in this discipline. One of the key problems in his view is that psychology research has been dominated by an emphasis on methods, in particular experimental designs. As a consequence, Flis argued, theoretical development has thus been disappointing in psychology. In Frege's metaphor this would be the consequence of an overemphasis on wood rather than the green of the tree. Of course, we should not let this happen in mathematics education research.

We shall have to resist two tendencies to which psychology, like other social sciences, has fallen prey. The first tendency is to try to be like a natural science. The second is to consider one type of research the gold standard and report it in standardized forms. The immense success of the natural sciences over the past centuries, its experimental methods, have become the gold standard of research, also for the social sciences. However, Smedslund (2009) points to the mismatch between experimental methods and the nature of psychological phenomena, and his point can be extended to many social and educational phenomena. Experimental methods tend to ignore fundamentally human characteristics such as intentionality, personal uniqueness, and locally shared meaning systems. As Flyvbjerg (2001) proposed, the social sciences should stop emulating the natural sciences, and rethink the kind of knowledge they intend to produce given that human beings are of a different nature than, say, electrons. In my view, the social sciences, including mathematics education, should have the courage to consider themselves human sciences with an eye for normativity, history, contingency, agency, and self-reflexivity (*cf.* Akkerman, Bakker & Penuel, in preparation). They should take reliability as subordinate to validity (Thomas, 2013) and privilege generativity and theoretical generalization over statistical generalization. This is hard, given the competition for resources with the natural and medical sciences, yet crucial to do justice to the nature of what we study: Human beings learning or teaching mathematics as a human activity (Freudenthal, 1973).

The second problematic tendency in psychology and educational research in the USA (*e.g.,* What Works Clearinghouse) is to consider experiments the gold standard and report them in standardized forms. The enormous increase of publications in the social sciences has created a need for easy and quick reading, hence standardization of where in a journal article particular information can be found (*e.g.,* APA, 2010). Frege's tree metaphor points to both the power and risk of this development: On the one hand, standardization helps authors and readers write and read a particular genre of research articles. Information can be easily found in predictable places in these articles. Quality is easier to assess if clear criteria are widely shared. On the other hand, standardization and so-called 'rigor' (Cartwright, 2019) may prevent new and interesting ideas—the generative life force of any discipline—from being published in our journals. I empathize here with Niss' (2018, 2019) concern.

Educational Studies in Mathematics

Right after Niss' keynote at PME-42, his main concerns were discussed among editors of ESM and during PME-43 these concerns returned to the table during a meeting of editorial board members and editors. We have talked about how to ensure that a rich variety of articles find their place in our journal that intends to represent the multifaceted nature of mathematics education research. It is true that a large percentage of ESM articles are empirical ones but there is certainly place for theoretical ones (*e.g.,* Niss & Højgaard, 2019; Pais, 2019; Scheiner & Pinto, 2019). There are examples of where the generativity or importance of ideas has been acknowledged by reviewers and editors. For instance, Konold *et al.* (2015) presented a useful framework on how students interpret data through different lenses—methodologically a nonstandard article but greatly appreciated in the community.

In line with Niss' analysis, we welcome a variety of submissions that do justice to the multi-faceted nature of mathematics education research, including its normative discussions. However, a journal is also dependent on submissions. The number of high-quality submissions of the types that Niss (2019) asks for is actually rather low. At the most recent ESM meeting two possible explanations were mentioned. The first is that it is actually hard to write and to recruit good non-empirical articles with important messages. This is a view I have heard also from editors outside mathematics education. Another explanation mentioned during the ESM meeting is that authors may hold limited views of what journals tend to publish. To remedy such self-imposed restraint, I like to emphasize that ESM welcomes any kind of submission that vitalizes mathematics education research, whether theoretical or empirical, qualitative or quantitative, standard or nonstandard. If authors are considering sending a manuscript that might not fit the typical format, they can write to the editor-in-chief for discussion. As editors we are open to continue the discussion of what is worth publishing in journals to ensure our discipline stays green and alive.

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Constructing and employing theoretical frameworks in (mathematics) education research

JINFA CAI, STEPHEN HWANG

Through his examination of the development of mathematics education research in issue **39**(2), Mogens Niss (2019) reminds us that as mathematics education continues to mature, it is perpetually necessary and instructive to take a step back and look at the big picture. By taking a broader view of our field, we can envision ways to improve our work as we move forward, not only in terms of the generation of new knowledge about the teaching and learning of mathematics but also in terms of doing research in mathematics education that has an impact on practice.

In his analysis, Niss brings particular attention to the state of theoretical frameworks in mathematics education research. He finds that the basis for such frameworks in our field is not sufficiently fully formed to support strict demands that researchers adopt them, and be bound by them. Mathematics education research has clearly evolved over time, whether in terms of the kinds of research questions that we ask, the methods that we employ to answer those questions, and the theoretical frameworks with which we work. Thus, we agree that in educational research, 'theoretical framework' is an evolving term and that the field is faced with a perpetual challenge to construct, reconstruct, and strengthen theories of teaching and learning. As Herbst and Chazan (2017) observed in their survey of theory in research on mathematics teaching, "our approach to providing an account of how theory has participated in our field's research on teaching cannot be one of contemplation of a stable object" (p. 103). Moreover, there has been an ongoing conversation in the wider educational research community as well as the mathematics education community about the role of theoretical frameworks in designing, conducting, and disseminating research (Grant & Osanloo, 2014; Leatham, 2019; Skott, Van Zoest & Gellert, 2013; Spangler & Williams, 2019).

In 2019, across a series of four editorials in the *Journal for Research in Mathematics Education* (JRME), we have argued that justifying the significance of a study requires developing a coherent chain of reasoning connecting the theoretical framework, the research questions, the research methods chosen to address the research questions, and the interpretation and discussion of the results. We therefore see the theoretical framework as a purposefully constructed structure that is essential in both the conduct and reporting of research in mathematics education. The intent of this communication is to explain how our thinking about theoretical frameworks both complements and, in one important point, conflicts with Niss' account.

A theoretical framework is purposefully constructed

Niss argues that the use of theory in mathematics education research has been quite varied, ranging from "nothing but a limited set of singular notions and terms" (p. 5) to a highly structured, logically coherent and connected set of concepts and claims. Certainly, there has been much diversity in how theory is used and positioned in mathematics education research, a fact that has attracted the attention of a number of scholars (*e.g.,* Herbst & Chazan, 2017; Stinson & Walshaw, 2017). However, Niss further positions the typical theoretical framework as a loose phenomenon—an "outline of a domain of entities, phenomena, or issues supposed to be captured by the framework, as well as […] a set of more or less connected concepts and terms" (p. 5). This sort of assemblage does indeed characterize what is called a theoretical framework in some manuscripts submitted to JRME. Other manuscripts include a more structured and tightly connected theoretical framework, closer to what Niss defines as a theory. Whether loosely or tightly constructed, though, we claim that the theoretical framework must be purpose-built to do essential work for both conducting and reporting a study in mathematics education.

We agree with Niss that the theoretical framework serves a multiplicity of purposes in current mathematics education research and moreover that researchers can and should adapt and integrate ideas and theoretical resources from multiple sources to construct useful frameworks. At the same time, given that the field has evolved to some degree over the past 50 years, it should be expected that the criteria by which we evaluate research (and theoretical frameworks) should also evolve. With respect to the theoretical framework, we stated, in an editorial in JRME issue **50**(3) that "to be useful, the theoretical framework should be constructed by the researcher as a critical part of conceptualizing and carrying out the research" (p. 219). This means that constructing a theoretical framework is a purposeful task for the researcher: "It is not simply found or chosen—ready-made, say, by searching the literature—nor can it be so generic that it provides little guidance for conducting the study or writing a report" (p. 219). Even when a theoretical framework adapts pieces from various sources, a practice that Niss encourages the field to be open to, the researcher must purposefully connect those pieces into a coherent whole that is useful in making and supporting decisions about the conduct and reporting of the study. In particular, as we will argue below, the theoretical framework is constructed for and through the justification of the significance of the research questions, the appropriateness of the chosen research methods, and the contribution of the findings.