

IRME and IRMEC: The Journal and The Conference

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What ground to cover in this talk

The purpose of the present talk is to give a brief introduction to the field of implementation research and replication studies in mathematics education and to the journal *Implementation and Replication Studies in Mathematics Education* (IRME) including its brief history as well as the now associated conference—the *Implementation and Replication Studies in Mathematics Education Conference* (IRMEC). The way I have chosen to go about this is to first provide some background information from the field illustrating the need for a dedicated outlet such as IRME. Second, with an outset in both previous and current literature, I will discuss definitions of implementation research and replication studies in mathematics education. Third, I will touch upon some of the theoretical constructs and the vocabulary that have come to play a role in these subfields of mathematics education research. Having done so, an account of IRME's brief history, its volumes, thematic editorials, and so-called impact sheets is provided. Finally, I touch upon the current conference, IRMEC, and our hopes for its future as well as for the future of these research efforts in general.

The need for a dedicated outlet

The idea for IRME can be viewed as a product of at least two related, yet independent, endeavours around the year 2017. Firstly, at the tenth *Congress*

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Jankvist, U. T. (2026). IRME and IRMEC: The Journal and The Conference. In M. S. Aguilar & M. Misfeldt (Eds.), *Proceedings of the First Implementation and Replication Studies in Mathematics Education Conference: IRMEC 2025* (pp. 15–27). Editorial SOMIDEM. <https://doi.org/10.24844/SOMIDEM/S3/2026/03-01>

of the European Society for Research in Mathematics Education (CERME) in Dublin, the Thematic Working Group (TWG) 23 on “Implementation of research findings in mathematics education” saw the light of day. The approval and planning of this TWG had of course been more than a year in the making prior to the congress in February 2017. The arguments for CERME to include such a TWG are summarised in the TWG’s final report:

Indeed, as researchers in mathematics education, we are frequently involved in putting previous empirical results and findings as well as theoretical constructs based on these to good use in mathematics classrooms, mathematics programs, mathematics teacher education, in-service teacher training, etc. In several countries there are ongoing developmental projects that rely heavily on previously documented research results. However, as researchers we often find ourselves in a peculiar situation when wanting to report on these activities, since such accounts do not necessarily fall under the usual paradigm of “research in mathematics education” and do not in a clear-cut manner qualify as either “empirical” or “theoretical research”. To assist in closing this “gap” the purpose of creating a new thematic working group focusing on aspects and issues related to the implementation of research results and findings, is to provide a venue for discussing, collecting and advance the “implementation research” aspects of our activities. (Jankvist et al., 2017, p. 3769)

TWG23 provided us with a dedicated forum for discussing aspects of implementation, and due to the proceedings of CERME it also provided us with a legitimate outlet for our research on the topic.

Secondly, in 2017 under the editorship of Jinfa Cai, the *Journal for Research in Mathematics Education* (JRME) featured a series of thematic editorials, addressing different themes related to the papers published in the associated issues. In the final issue of 2017, the theme was “making classroom implementation an integral part of research” (Cai et al., 2017). Cai and colleagues wrote:

In recent years, there has been increased interest in research that investigates the effectiveness of curricula on students’ learning by taking implementation into consideration (Century & Cassata, 2016; Lloyd, Cai, & Tarr, in press; Morris, 2012; National Research Council, 2004; Remillard, 2005). It has become “a phenomenon in its own right” (Fullan & Pomfret, 1977, p. 336). It also has its own label, *implementation research* (Century & Cassata, 2016; Nilsen, 2015), and its own journal in the medical profession, *Implementation Science*. According to Schoenfeld’s (2016) review of research in mathematics education, a recognition during the 1980s that educational innovations needed to be followed into the classroom marked a significant shift in research approaches. Clearly, issues of implementation are no longer being ignored. (Cai et al., 2017, p. 344)

The main purpose of the JRME editorial was, however, not to highlight the conduct of implementation research, but rather to argue that

implementation should be an integral part of research, and not something “added on” and left to teachers to figure out on their own:

The point we wish to make in this editorial is that including studies of implementation might not be enough. If researchers hope to impact practice, they might need to embed implementation as an inseparable aspect of intervention design. If researchers leave implementation to teachers, or if they study implementation as a phenomenon separate from the design of an intervention (e.g., writing and testing curricula), they could miss a chance to boost the impact of their work. (Cai et al., 2017, p. 344)

In 2018, the first issue of JRME featured yet a thematic editorial (and issue), this time addressing “the role of replication studies in educational research” (Cai et al., 2018). Upon noticing that the number of replication studies in mathematics education research, including JRME, is rather limited, Cai and colleagues speculated:

The reasons for the limited number of replication studies in mathematics education research are not entirely clear. One possible cause is that the way in which replication is typically conceptualized is too narrow to effectively serve our field. Another possibility might be the lack of a generally agreed-on conceptualization of replication studies that would guide the field’s understanding of what replication studies are, what they are meant to do, and why the field should engage in them. (Cai et al., 2018, p. 3)

Building on the summary by Polio and Gass (1997), Cai and colleagues distinguished between “exact replications” and “conceptual replications” (see following sections also), and argued that conceptual replications may very well be better fitted to the research area of mathematics education, since these may

... bypass a common concern about replications, a concern that could discourage researchers from conducting replications at all. As Easley, Madden, and Dunn (2000) point out, researchers who conduct replications are faced with a dilemma if their results do not replicate the original results. Do such findings disprove the prior findings or are they simply the result of the replication design? This question is relevant for exact replications but does not need to apply to conceptual replications. The logic built into conceptual replications shifts the purpose from proving or disproving a finding to understanding more completely the conditions that explain the finding. In other words, well-designed conceptual replications contribute new information to the field regardless of the outcomes. (Cai et al., 2018, p. 7)

So, even though journals such as JRME and *Educational Studies in Mathematics* (ESM), etc. in principle do accept replication and implementation studies, it appeared clear that a dedicated outlet potentially could boost such studies. At least, it would provide a space in which to naturally have discussions such as those reflected in the quotes above. Such discussions will of course include the very definitions of what is to be

considered and accepted as implementation research and replication studies in mathematics education research.

Definitions of implementation research in mathematics education

Implementation research has emerged as a response to a longstanding concern within mathematics education: namely, how research findings, innovations, and educational designs can be successfully translated into educational practice. Although questions of implementation have been present since the early curriculum reform movements and the New Math era, implementation has only recently become an explicit object of research in its own right (Artigue, 2021; Koichu et al., 2021). At a general level, implementation research is concerned with the relationship between educational innovations and the contexts in which they are enacted. A widely cited definition from the broader educational research literature describes implementation research as the systematic study of innovations enacted in controlled settings or ordinary practice, the factors that influence their enactment, and the relationships between innovations, influential factors, and outcomes (Century & Cassata, 2016). This definition has become particularly influential in recent mathematics education discussions of implementation and has served as a conceptual point of departure for much of the work developed within the CERME implementation community and subsequently within IRME (Aguilar et al., 2019; Koichu et al., 2021).

Within mathematics education, implementation is generally understood as extending beyond dissemination. Dissemination concerns making research results, resources, or innovations available to potential users. Implementation, by contrast, concerns what happens when these resources are taken up and enacted in practice. It therefore focuses on processes of adoption, adaptation, use, and institutionalization rather than on the mere existence or distribution of educational innovations (Century & Cassata, 2016; Jankvist et al., 2021b). A central feature of implementation research is its concern with change. Educational innovations are typically introduced with the intention of changing existing practices, whether these involve classroom instruction, curriculum materials, teacher professional development, assessment systems, digital technologies, or broader educational policies. Consequently, implementation research investigates not only whether change occurs, but also how, why, for whom, and under what conditions such change takes place (Century & Cassata, 2016; Koichu et al., 2021).

Recent conceptualizations within mathematics education have emphasized the inherently social and collaborative nature of implemen-

tation. In the working definition developed within CERME's TWG23, implementation is described as a change-oriented process in which a relatively well-defined resource—such as a research finding, curriculum, digital tool, textbook, or policy—is endorsed and enacted through interactions between those promoting the resource and those adapting it to local contexts (Aguilar et al., 2019). From this perspective, implementation is not understood as a linear transfer of knowledge from researchers to practitioners. Rather, it is viewed as a dynamic process involving negotiation, adaptation, and shifts in agency among multiple stakeholders. Implementation research therefore differs from effectiveness research. Whereas effectiveness studies primarily seek to determine whether an intervention produces desired outcomes, implementation research examines the processes through which such outcomes are achieved or inhibited. It investigates how characteristics of the innovation itself, contextual conditions, organizational structures, stakeholder perspectives, and local practices interact during implementation processes (Century & Cassata, 2016). In this sense, implementation research seeks not only to determine whether innovations work, but also to understand the mechanisms and conditions that make them work.

Several authors have further argued that implementation research should be understood as an essential bridge between research and practice. Artigue (2021) characterizes implementation studies as research whose fundamental purpose is to pave scientifically sound pathways from basic research to educational practice. Similarly, Koichu et al. (2021) note that implementation research addresses the longstanding challenge of making mathematics education research consequential beyond the contexts in which it was originally produced. From this perspective, implementation research contributes not only to improving educational practice but also to refining and strengthening research itself by testing its practical viability under authentic conditions.

Definitions of replication studies in mathematics education

Compared to implementation research, replication studies constitute a relatively newer and less established area within mathematics education research. Nevertheless, interest in replication has increased substantially in recent years, not least due to broader discussions concerning reproducibility, robustness, and generalizability across the social sciences (Aguilar, 2020; Cai et al., 2018). At a general level, replication refers to the process of conducting a new study that revisits previously published research findings to investigate their validity, robustness, applicability, or theoretical interpretation (Aguilar, 2020; Firmin, 2008). As mentioned above, a commonly cited distinction, originally discussed by Polio and Gass (1997)

and adopted by Cai et al. (2018), is that between exact (or direct) replication and conceptual replication. Exact replication attempts to reproduce an original study as closely as possible, maintaining the same methodological procedures, instruments, and conditions. The purpose is to verify the reliability of the original findings. However, as several authors have noted, exact replication is often difficult—if not impossible—to conduct within educational research because teaching and learning involve complex social interactions situated in unique contexts (Cai et al., 2018; Polio & Gass, 1997). For this reason, conceptual replication has generally been viewed as more suitable for mathematics education research. Conceptual replication retains the central research question, hypothesis, or theoretical construct of a previous study while deliberately varying aspects of the methodology, context, sample, or analytical approach (Cai et al., 2018). The purpose is not merely to determine whether the original findings can be reproduced, but rather to understand more fully the conditions under which those findings emerge. As Cai et al. (2018) argue, conceptual replications shift attention away from simply confirming or disconfirming previous results towards identifying the factors that explain them.

This understanding aligns with broader perspectives on replication in mathematics education. Aguilar (2020) emphasizes that replication studies contribute both to understanding and to truth. On the one hand, they help researchers delineate the boundaries and conditions of research findings, thereby improving understanding of educational phenomena. On the other hand, they provide greater confidence in research results by examining their robustness across different contexts, populations, and methodological approaches. Similarly, Schoenfeld (2018) argues that replication serves to guard against statistical accidents, context-specific interpretations, and confirmation bias, while providing stronger foundations for subsequent theoretical development.

Replication studies can take a variety of forms. They may investigate whether findings obtained in one educational setting also emerge in another, whether a theoretical interpretation remains viable when alternative methodologies are employed, or whether a previously successful intervention continues to produce similar outcomes under different conditions. As such, replication is not only concerned with the reproducibility of results but also with the refinement, extension, and theoretical elaboration of prior research (Aguilar, 2020; Star, 2018). In mathematics education specifically, replication studies have an important role to play in establishing what might be considered “solid findings” within the field. Whereas individual studies often provide evidence under particular circumstances, replication studies can help to clarify the extent to

which findings are transferable, generalizable, or dependent on contextual factors. Consequently, replication contributes not only to the accumulation of knowledge but also to the development of a more robust and self-correcting research discipline (Aguilar, 2020; Cai et al., 2018).

Theoretical resources and vocabulary underpinning our field

As implementation and replication studies have gradually emerged as identifiable areas of mathematics education research, a corresponding body of theoretical resources and specialized vocabulary has begun to develop. Although implementation and replication research draw on theories and frameworks originating both within and outside mathematics education, a growing degree of conceptual coherence can now be observed across publications, conferences, and research initiatives (Artigue, 2021; Koichu et al., 2021). One important characteristic of implementation research is its theoretical pluralism. Rather than relying on a single overarching theory, implementation studies typically combine theoretical perspectives according to the nature of the innovation under consideration and the questions being addressed. Consequently, implementation research often draws simultaneously on several theories from mathematics education, educational change, organizational studies, policy research, and implementation science (Artigue, 2021; Century & Cassata, 2016).

A foundational concept within implementation research is that of an *innovation*. Borrowing from Rogers' (2003) influential work on diffusion of innovations, innovations are commonly understood as ideas, practices, resources, or interventions that are perceived as new by those who encounter them. Within mathematics education, innovations may include research findings, curricular materials, digital technologies, professional development programs, pedagogical approaches, assessment formats, or educational policies (Jankvist et al., 2021b). Implementation research is therefore fundamentally concerned with understanding how such innovations are enacted, adapted, and sustained in practice.

Closely related is the concept of *stakeholders*. Implementation processes involve multiple actors occupying different positions within educational systems, including researchers, policy makers, curriculum developers, school leaders, teacher educators, teachers, and students. Different stakeholders often attach different values, expectations, and purposes to the same innovation. Understanding implementation consequently requires attention to how these various perspectives interact throughout the implementation process (Jankvist et al., 2021a).

A third central construct concerns *implementability* (Koichu et al., 2024). This notion refers to the extent to which a research finding, educational design, or innovation possesses characteristics that make

successful implementation feasible. Recent discussions have emphasized that implementation outcomes depend not only on the quality of the innovation itself, but also on the degree to which it can realistically be enacted within existing educational systems and practices (Koichu et al., 2021).

Another frequently used concept is that of *scaling* or *scaling up* (e.g., Coburn, 2003). Whereas implementation may occur within a single classroom, school, or local context, scaling concerns the expansion of innovations across larger populations, institutions, or educational systems. Research on scaling investigates how innovations can maintain their effectiveness while being adapted to increasingly diverse contexts. Questions concerning fidelity, adaptation, sustainability, and institutional support become particularly salient in such studies (Century & Cassata, 2016; Koichu et al., 2021).

Implementation studies also increasingly employ the construct of a *Theory of Change* (ToC). A Theory of Change articulates the assumptions and causal mechanisms through which an innovation is expected to produce desired outcomes (Jankvist et al., 2021a). It thereby provides both guidance for implementation and a framework for evaluation. Recent work in mathematics education has emphasized that explicit and shared theories of change are essential for aligning the expectations and actions of different stakeholders throughout implementation processes (Chen, 2015; Jankvist et al., 2021a).

Replication research has developed a partially overlapping but distinct vocabulary. Here, concepts such as *direct replication*, *close replication*, *conceptual replication*, *external replication*, and *generalizability* are central (Aguilar, 2020). These constructs support investigations into the robustness, transferability, and boundary conditions of research findings. Replication studies often seek to determine whether findings remain valid when populations, contexts, methodologies, or theoretical perspectives change.

Across both implementation and replication research, several recurring themes can be identified. These include questions concerning validity, robustness, adaptation, context sensitivity, sustainability, transferability, and educational impact. Together, these themes reflect a shared concern with understanding what happens when research findings move beyond the contexts in which they were originally produced. The theoretical resources supporting implementation and replication studies are correspondingly diverse. They include diffusion of innovations theory (Rogers, 2003), implementation science (Century & Cassata, 2016), theory-driven evaluation (Chen, 2015), design-based research (Cobb et al., 2003), scaling frameworks, organizational theories of change, and a wide range of mathematics-education-specific theories that inform particular innovations

and interventions (Artigue, 2021). Rather than replacing existing mathematics education theories, implementation and replication research build upon them while simultaneously introducing additional conceptual tools for understanding how research findings travel, transform, and persist in practice. Table 1 provides an overview of a selection of the most common vocabulary of implementation research and replication studies.

Table 1

Short glossary table related to implementation research and replication studies.

Term	Short definition
Innovation	Research-based change introduced into practice
Stakeholder	Actor affected by or involved in implementation
Implementability	Ease with which an innovation can be enacted
Scaling	Expansion across contexts or systems
Theory of Change (ToC)	Explicit model linking actions and outcomes
Fidelity	Degree of adherence to intended design
Adaptation	Modification during implementation
Conceptual Replication	Testing a finding under altered conditions
Direct Replication	Reproducing a study as closely as possible

The journal: IRME

In 2018, discussions began about launching a dedicated journal focused exclusively on implementation research and replication studies in mathematics education. After consultations with international publishers, an agreement was signed with the Dutch publishing house Brill, leading to the establishment of the journal IRME.

The journal published its first issue in 2021. Its structure includes:

- One volume per year
- Two issues per volume
- Four papers per issue
- A substantial thematic editorial in each issue

Across its first five volumes, IRME editorials have addressed central questions such as:

- What should be replicated?
- Fidelity in implementation.
- Post-implementation perspectives.
- Internationalization of implementation research.

- Implementability.
- The state of implementation research.
- The nature of “solid findings” in mathematics education.

These editorials collectively trace the evolution of implementation and replication research as a structured domain within mathematics education.

As for original research papers, IRME explicitly bridges research production and research re-production, and it welcomes high-quality empirical and theoretical studies addressing, amongst other themes:

- Implementation of mathematics education research into practice,
- Comparative analyses of implementation initiatives,
- Scaling studies,
- Methodological innovations in implementation research,
- Replication studies testing validity and generality,
- Replications using alternative theoretical perspectives,
- Studies examining interventions across contexts and populations.

In light of the considerations addressed previously in this talk, IRME adopts broad understandings of implementation research and replication studies. For implementation research, the journal welcomes studies that investigate the enactment, adaptation, scaling, institutionalization, evaluation, and sustainability of research-informed innovations in mathematics education. Such innovations may include teaching approaches, curricular materials, technological resources, professional development initiatives, educational policies, or broader systemic reforms. What unites these studies is a common concern with understanding how research-based innovations interact with practice, and with generating knowledge that can support meaningful and sustainable educational change. For replication studies, the journal welcomes studies that revisit previous empirical or theoretical work in order to test, extend, reinterpret, or further specify existing findings. This includes both close and conceptual replications, studies conducted by original researchers as well as independent research teams, and investigations aimed at understanding the conditions under which previously reported results do—or do not—hold. In line with these emerging traditions, IRME welcomes contributions employing diverse theoretical perspectives and methodological approaches. What unites such studies is not adherence to a particular theoretical framework but a shared concern with understanding how mathematics education research findings are implemented, adapted, scaled, replicated, evaluated, and sustained across educational contexts.

In 2024, IRME was accepted into *Scopus*, marking an important milestone in its institutional consolidation.

Finally, it should be mentioned that a distinctive feature of IRME is the inclusion of an *impact sheet* for each article. These short, open-access

summaries communicate the practical and systemic implications of the research. The format parallels the intended structure used in IRMEC proceedings, thereby creating continuity between conference contributions and journal publications.

The conference: IRMEC

In early 2024, the idea of a specialized international conference dedicated to implementation and replication research was developed: IRMEC. IRMEC is designed as a working conference, emphasizing presentation of work in progress, structured feedback, community building, introduction of scholars to implementation and replication frameworks, and encouragement of high-quality journal submissions.

Unlike the CERME and TWG23 mentioned above, IRMEC is explicitly international in scope and intends to be hosted in various regions of the world, beginning with Mexico City in 2025. The IRMEC proceedings follow a concise format of three-page submissions, clear articulation of how implementation or replication is conceptualized, presentation at the conference required, and peer review by the International Program Committee of the conference.

Final remarks

In conclusion, it seems fair to argue that the establishment of IRME and IRMEC represents a serious attempt at a structural consolidation of implementation and replication research in mathematics education. Together, they provide a scholarly outlet, a shared conceptual vocabulary, a research community, and not least a pathway from innovation to systematic investigation and scaling. Implementation and replication research should not be understood merely as yet another specialized niche within mathematics education research. As suggested by recent efforts to conceptualize and theorize implementation in our field (e.g., Koichu et al., 2021), these research areas operate at a meta-level. They are concerned not primarily with particular mathematical topics, educational technologies, or instructional approaches, but with understanding how mathematics education research itself produces, validates, transfers, adapts, and consolidates knowledge across contexts and over time.

From this perspective, implementation and replication studies address fundamental questions concerning the relationship between research and practice, the robustness and generalizability of research findings, the conditions under which innovations can be sustained and scaled, and the mechanisms through which educational change occurs. They therefore potentially contribute not only to improving practice, but also to

strengthening the scientific foundations of mathematics education as a research field. By foregrounding implementation and replication as core research activities rather than peripheral concerns, IRME and IRMEC specifically aim to support a more cumulative, robust, and internationally connected mathematics education research community. Ultimately—and hopefully—their success will not be measured merely by the number of studies published or conferences organized, but by the extent to which they contribute to a deeper understanding of how research-informed educational change can be achieved, sustained, and critically examined.

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