Chapter 25

ZDM Mathematics Education—Its Development and Characteristics

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Abstract This chapter provides a description of *ZDM Mathematics Education*, one of the oldest journals in mathematics education. Although *ZDM Mathematics Education* was founded in Germany, it was oriented internationally since its beginning. The historical development of *ZDM Mathematics Education* and its characteristics are described, namely the exclusive publishing of thematic issues by invited guest editors, who invite the contributors of the papers. This feature distinguishes *ZDM Mathematics Education* from many other journals in mathematics education. Despite the invitation-only submission basis, all papers undergo a rigorous peer-review process. The review criteria, the reviewing processes, and the editorial decision process are described, which are currently common to the major mathematics education journals. The journal's foci and orientation have evolved significantly since its founding in 1969, with a strong inclusion of empirical research oriented towards a broad international audience, but adhering to its roots by emphasising subject-based themes.

Keywords Journals in mathematics education • *ZDM Mathematics Education* • Academic publishing • Review criteria • Editorial decisions

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25.1 Development and Scope of *ZDM Mathematics Education*

ZDM Mathematics Education has a distinguished lineage, reaching back to the origins of mathematics education as a discipline in the 1960s. First published in 1969 under the name *Zentralblatt für Didaktik der Mathematik*, abbreviated *ZDM*, the journal then highlighted important international events in mathematics education, with a largely German readership.

The journal was originally founded as an informational and encyclopaedic review on mathematics education. It was initiated by Emmanuel Röhrli, who at that time was the head of the editorial staff for mathematics and physics at Klett Publishing House, and Hans-Georg Steiner, who was at that time working at the Centre for Didactics of Mathematics at the University of Karlsruhe. The Internationale Mathematische Unterrichtskommission (IMUK)—International Commission on Mathematical Instruction (ICMI)—supported the journal as co-publisher. In June 1969 the first edition of the new journal, with the abbreviated name ‘*ZDM*’, came out.

The journal was characterised by its division into two parts, according to the twofold function of *ZDM*: the documentation section, which was defined as the main part of *ZDM*, and the analysis section. The documentation section gave an overview of new publications and was printed on cards that could be detached. The analysis section was meant to reflect on the current discussion in mathematics education. Therefore, the analysis section mainly consisted of papers devoted to a specific theme edited by invited mathematics educators. With a few exceptions the early issues of *ZDM* consisted of thematically oriented issues, which we call nowadays special issues. Hans-Georg Steiner, who had in 1973 moved to the recently founded Institute for Didactics of Mathematics in Bielefeld, devoted his time to the internationalisation of the documentation section and it attained a significant degree of success. In his capacity as chair of the programme committee of the 3rd International Congress on Mathematics Education (ICME-3), which had taken place in 1976 in Karlsruhe, Hans-Georg Steiner had seen the necessity of international publication possibilities in mathematics education as well as the need to review the growing body of publications in this area. He was supported by Heinz Kunle from Karlsruhe, who had served as chair of the local organising committee of ICME-3. Until his death in 2004, Hans-Georg Steiner remained closely connected with *ZDM* and participated actively in the internationalisation process of *ZDM*. Thanks to him, *ZDM* had an English title ‘*International Reviews on Mathematical Education*’ from its very beginning.

In 1976, the responsibility for the journal was delegated to the *Zentralstelle für Atomkernenergie-Dokumentation* (ZAED)—Nuclear Energy Documentation Centre. In 1978 the journal was taken over by the Fachinformationszentrum Energie, Physik, Mathematik (FIZ)—the Leibniz Institute for Information—in connection with the demand for modernisation and internationalisation. Gerhard König, who had originally worked for the publishing house Klett became Managing Editor of *ZDM* and ZAED and kept these positions until his retirement in 2004

(for details on Gerhard König see the obituary by Kaiser 2016). He officially represented ZDM at all leading conferences in mathematics education and caused the journal to become well known already very early in the history of the international community on mathematics education.

ZDM was supported by the *Verein zur Förderung der Didaktik der Mathematik* (Organization for the promotion of didactics of mathematics) under the chairmanship of Heinz Kunle and Hans-Georg Steiner and the FIZ. There the relevant international journals were evaluated for the documentation section, and, based on co-operation with various national and international institutions, many non-German publications were included in the database on mathematics education. In 1998 the former documentation section of ZDM was integrated into the *European Mathematical Information Service* so that it became available electronically as a web-based database.

In 2001 the analysis section was excluded from the ZDM print version due to budgetary reasons. Since then the analysis section has been available only electronically. The new electronic journal was published and edited under the auspices of the *Fachinformationszentrum Karlsruhe* (FIZ Karlsruhe), together with the *European Society for Mathematics* (ESM) and the *Gesellschaft für Didaktik der Mathematik* (GDM)—Society of Didactics of Mathematics—which took over the rights and responsibilities of the dissolved and above mentioned organisation *Verein zur Förderung der Didaktik der Mathematik*.

In 2006 further changes followed, which resulted in an official separation of the two parts of ZDM, namely the reviews and the analysis sections, a fact formerly reflected by the two names. The original documentation section of ZDM, the actual database, was distributed under the name *MATHDI/MATHEDU—International Reviews in Mathematical Education*, while the former analysis section was published under the title *Zentralblatt für Didaktik der Mathematik*. At the same time the international nature of the journal was developing further, which became obvious from the international editorial board and the exclusive use of the English language in its publications.

In the year 2007, the 39th volume of ZDM, Springer started to publish the journal. The original abbreviation of the journal ZDM was maintained, in order to refer to its origin. However, with the implementation of a new sub-title *The International Journal on Mathematics Education*, the opening to an international audience became clear, offering new opportunities, both in scope and reach. The core idea was to continue to publish focused thematic volumes on issues of central importance, such as curricula, assessment, problem solving, and professional development. Authors and editors were to represent the best of mathematics education around the world, and the readership was intended to be equally broad.

With Springer entering the stage, an international editorial board was implemented, thus integrating international scholars with those who were German-speaking, including the continuing editor-in-chief, Gabriele Kaiser, who had already worked in this capacity since 2004. The bimonthly frequency of publication was maintained, with six issues per year. However, in contrast to the previous publication form, the journal was published both in printed format and in a

web-based online version, the latter offering access to a much broader international readership via the worldwide presence of Springer.

The first issue published by Springer was dedicated to the memory of Hans-Georg Steiner and his efforts to establish mathematics didactics as a scientific discipline. With this issue *ZDM* went back to its roots in honour of Hans-Georg Steiner, whose constant endeavour made the existence of *ZDM* possible.

The structure of *ZDM*, which had been developed during the last decade, was not changed. Thematically based issues, edited by invited guest-editors with invited papers, still characterised the journal, representing topical mathematics educational approaches and the current state in mathematics education. This practice allowed the publishing of coherent issues describing the state-of-the-art on selected topics and reflecting topical trends of the discussion on mathematics education by invited well-known scholars.

The themes of the issues in the last decade were multifaceted; however, there were recurrent topics, which can be grouped around the following broader themes:

- **Comparative studies, especially between East Asian and Western countries:**
  - Effective mathematics teaching in East and West
  - Asia Pacific focus on mathematics classrooms
  - Exemplary mathematics instruction in East Asia
  - Curriculum research in China and the US
  - Values in East Asian mathematics education
  - Cross-national studies on teaching and learning mathematics
  - Lesson study in mathematics: an international perspective.
- **Teacher education and teacher's professional development:**
  - Empirical research on mathematics teacher education
  - Creating and using representations of mathematics teaching in teacher development
  - Developing teachers' expertise
  - Measuring teacher knowledge from a cross-national perspective
  - Theoretical frameworks in research on and with teachers
  - Re-sourcing teacher work and interaction
  - Promoting professional development of didacticians and mathematics teachers
  - Evidence-based continuous professional development
  - Perception, interpretation and decision making
  - Impact of university teacher education programs
  - Bridging teachers' professional knowledge and instructional quality.
- **Psychological topics:**
  - Flexible/adaptive use of strategies and representations
  - Metacognition in mathematics education
  - Cognitive neuroscience and mathematics learning
  - Cognitive neuroscience and mathematics learning—revisited after five years

- Mathematical thinking and learning
  - Beliefs and beyond
  - Creativity in mathematics education/Mathematical creativity and psychology
  - New perspectives on learning and cognition
  - Inhibitory control in mathematics education
  - Emotions and motivation in mathematics education
  - Applying (cognitive) theory-based instructional design principles in mathematics teaching and learning
  - Mathematical word problem solving: psychological and educational perspectives
  - Assessment and understanding young children's mathematical minds.
- **New technology and New media:**
    - Usage of dynamic mathematics technologies
    - Historical aspects of the use of technology and devices
    - Handheld technology in mathematics classrooms
    - Interoperable interactive geometry
    - Online mathematics education and e-learning
    - Digital curricula in mathematics education.
- **Mathematics-specific topics:**
    - Learning, teaching and using measurement
    - Whole number arithmetic and its teaching and learning
    - Research on early childhood mathematics teaching and learning
    - Probability in reasoning about data and risk
    - Innovations in statistical modelling to connect data, chance and context
    - Teaching and learning of calculus
    - Research on teaching and learning in linear algebra
    - From patterns to generalization: development of algebraic thinking
    - Geometry in primary school
    - Numeracy/Numeracy and vulnerability in adult life.
- **Research on classroom activities:**
    - Problem solving around the world
    - Didactical and epistemological perspectives on mathematical proof
    - Mathematical evidence and argument
    - Interdisciplinarity in mathematics education
    - 21st century skill and STEM teaching and learning
    - Implementation of inquiry-based learning
    - Visualization as epistemological learning tool
    - Classroom-based interventions in mathematics education
    - Scaffolding and dialogic teaching
    - Textbook research in mathematics education and its recent advancement
    - Language and communication: empirical research and theoretical frameworks
    - Empirical research on the teaching and learning of mathematical modelling

- Studying instructional quality in mathematics through different lenses
- Mathematical tasks and the student.
- **General aspects on mathematics education:**
  - Didactics of mathematics as a scientific discipline—in memoriam Hans-Georg Steiner
  - Turning points in the history of mathematics teaching
  - New perspectives on gender
  - Enacted mathematics curriculum
  - Material ecologies of teaching and learning
  - Socio-economic influences on mathematical achievements
  - New perspectives on the didactic triangle
  - Survey on research on mathematics education
  - Mathematical working spaces in schooling
  - Identity in mathematical education
  - The role of mathematicians' practice in mathematics education research.
- **Methodological issues:**
  - Networking strategies for connecting theoretical approaches
  - Enactivist methodology
  - Design research with a focus on learning processes
  - Assessment in mathematics education: issues regarding methodology, policy and equity.
- **Country-specific issues:**
  - Nordic issue on research
  - South American tapestry of trends
  - Turkish issue on research developments
  - Features of Korean mathematics education.

Since 2010, seven issues per year have been published. Each issue published is comprised of about 12–14 original papers, and additionally one survey paper on the state-of-the-art on the topic of this issue, and one or two commentary papers. As a result of this format, about 90 manuscripts are published per year, covering around 1100 pages (in standard paper-size and two-column format). With the introduction of a survey paper on the state-of-the-art in 2014, *ZDM Mathematics Education* aimed to give even more concisely an overview of the latest developments concerning the topic of the specific issue. Commentary papers, which were introduced a few years earlier, aimed to provoke a discussion on the theme of the issue, which could not always be achieved. Therefore, the practice of including commentary papers was discontinued in recent years.

A further milestone in the development of *ZDM The International Journal on Mathematics Education* was the change of the subtitle in 2015 leading to the current title of the journal as ***ZDM Mathematics Education***. The main reason behind this decision was the ambiguity of the original subtitle *The International Journal on*

Mathematics Education, which led to diverse perceptions of the thrust of the journal, which was not helpful for shaping a clear identity for this journal. It was therefore an obvious consequence to choose a distinct sub-title complementing *ZDM* and keeping the original roots. With the current name *ZDM Mathematics Education*, the aim is an unambiguous title preserving the roots as *Zentralblatt für Didaktik der Mathematik*.

Furthermore, *ZDM Mathematics Education* is characterised by strong support with an editorial office and language editing for papers of non-native speakers of English. This strong support by Springer allowed the establishment of a journal with a broad range of themes and topics reaching as readers not only European or North American mathematics educators. In contrast *ZDM Mathematics Education* is now widely accepted in many Asian countries. The strong German roots of *ZDM Mathematics Education* are apparent in the high importance of subject-specific issues and subject-related analyses in many issues, reflecting the appreciation for and priority given to the subject mathematics and content-related reflections.

Currently *ZDM Mathematics Education* is accepted widely and listed as one of the seven leading journals in mathematics education (see Nivens and Otten 2017; Williams and Leatham 2017) and included in many indexing services, amongst others the *Emerging Sources Citation Index*, *Scopus*, *Google Scholar*, and *ERIC System Database*.

With more than 200,000 downloads per year, papers in *ZDM Mathematics Education* receive remarkable recognition. Overall, the impact of *ZDM Mathematics Education* measured by various impact factors confirms that *ZDM Mathematics Education* is one of the leading journals in mathematics education (see the journal's website for more information, <https://www.springer.com/education+%26+language/mathematics+education/journal/11858>).

Although *ZDM Mathematics Education* publishes only invited papers, all these papers have to follow the guidelines now usual for all major journals in mathematics education. They undergo a rigorous peer-review process, which is described in the next section, and which is similar to the review system in other relevant journals in mathematics education.

25.2 The Submission, Review and Decision Process

A manuscript submitted to *ZDM Mathematics Education* should be of high quality and make a significant contribution to the field. In addition, the article should be an original paper and not have been published elsewhere. *ZDM Mathematics Education* provides guidelines for papers, as do all major journals in mathematics education, which need to be followed by the provisional authors. The main restriction is the length of the submitted manuscript: manuscripts should be no shorter than 40,000 characters including spaces and no longer than 60,000 characters including spaces, and covering abstract, references and a possible appendix. The papers have to be written in English (either American or British English).

The guidelines for the authors are displayed in the website of *ZDM Mathematics Education*.

The papers are submitted electronically via an editorial system, *ZDM Mathematics Education* uses the *Editorial Manager* provided by Springer. The editorial office checks the manuscripts for their compliance with the guidelines.

The papers submitted to the journal undergo a peer-review process by the guest editors and external review by invited experts. Three reviewers are invited to evaluate the paper according to the following criteria, which are displayed in the website of *ZDM Mathematics Education*. Based on these criteria the reviewers are asked to write a commentary on the paper analysing the strengths, weaknesses and limitations of the paper and the research reported. The reviewers are asked to make their comments as explicit, detailed and constructive as possible, in order to provide the editor-in-chief and the guest editors with a sound basis for their decision and to help the author to revise the paper, if necessary. Reviewers have the discretion to differentiate between a commentary to the editors and comments to the authors.

The scientific quality of the paper is evaluated along the following criteria:

- * Is the paper a meaningful contribution to mathematics education research and is it distinct from other work of the author(s)?
- * Is the approach or the argumentation original and does the paper develop new insights into relevant research questions on mathematics education?
- * Does the paper review previous studies and does it consider the relevant literature in the field? Does it avoid unnecessary self-references?
- * Is the theoretical frame adequate, i.e., is there an appropriate alignment between the theoretical framework and the questions asked or the problems tackled?
- * Is the methodological approach adequate, i.e., do the research methods and analyses match the problem or question?
- * Are the argumentations consistent, are the claims and conclusions justified in an acceptable way, do they follow logically from the data or other information presented?"

The quality of the presentation is assessed along these criteria:

- * Is the title suitable and is the abstract distinct and adequate?
- * Is the writing lucid, clear, and well-organised?
- * Is the quality of the figures and tables adequate?"

Finally, the reviewers are asked to make one of the following recommendations:

- * Accept without changes
- * Accept with minor changes
- * Accept with significant changes
- * Rewrite the paper
- * Reject the paper.

(Source: Information for Reviewers <https://www.springer.com/education+&+language/mathematics+education/journal/11858>).

Based on the recommendations of the reviewers a decision letter is sent out by the editor-in-chief, which contains a decision and summarises the necessary changes. This decision is sent out on average 60 days after submission, which is quite fast. As *ZDM Mathematics Education* deals only with invited papers by carefully selected authors, the quality of most papers is already quite high at the first submission. The most frequent decision is therefore accept with significant changes, which requires the authors to revise the paper strongly, but allows them to keep the core of the paper. Revision time is usually two months. The authors are asked to submit not only their revised manuscript, additionally they have to provide a letter to the reviewers and the editor-in-chief, in which the changes made are described, in point form. This practice has been established by nearly all academic journals in recent years and allows the authors to explain which changes have been made, and to justify why required changes have not been done, for example due to space restrictions or conflicting requirements by the reviewers. The revised paper is reviewed another time by the same reviewers (usually only two are invited) and after two months at the latest, the next decision is sent out. Usually two to three rounds of revision are needed before the paper can be accepted. For non-native speakers *ZDM Mathematics Education* provides language editing, in which the correctness and adequacy of the academic expressions is checked. On average 16 days after acceptance of the manuscript the paper is available online at Springer Link and can be quoted with its DOI.

This fast and transparent process has led to high satisfaction of the authors, who rated their publishing experience with *ZDM Mathematics Education* as excellent or good.

To close this description of *ZDM Mathematics Education* I would like to summarise common errors being made by many authors who submit their paper to this journal or to others, and which should be avoided, when publishing in *ZDM Mathematics Education* or elsewhere.

Overall, a manuscript has to be based on accepted scientific standards; it should report new scientific results based on high-level research and avoid providing anecdotal evidence.

Furthermore, a clear structure of the paper is necessary, which is quite often not the case for the first submission of the manuscript. The following structure is advisable for papers based on empirical research; theoretically oriented papers or papers oriented towards constructive aims such as the development of learning environments or teaching approaches may follow another structure. This structure is advisable for papers, or at least a paper has to contain these parts:

- Introduction, in which the research question or research aim is roughly described functioning as advance organiser;
- Literature review on the state-of-the-art on the research question or research aim;
- Development of the detailed research questions or research aims referring to the literature review;

- Description of the theoretical framework on which the study is based, the important theoretical conceptualisations or constructs;
- Description of the underlying methodology;
- Display of the results;
- Summary of the results and interpretations;
- Discussion of the limitations of the study, conclusions, potential to generalise and further prospects.

One central error often made within the first version of a manuscript is that a clear research question or research aim is missing, so that the central argumentation of the manuscript remains vague or unclear. It is indispensable to develop a clear research question or, if that is not possible, to formulate at least a precise research aim. A rough research question should be formulated at the beginning of the paper and should already be mentioned in the abstract. Details of the research question should follow after the literature review, in which a clear research gap has been pointed out, which the paper intends to close.

A common problem of the literature review is the usage of outdated literature or non-consideration of the most recent literature, which means that the literature review is not really covering the current state-of-the-art. Furthermore, the literature review is quite often too narrow and focused only on the country or the culture of the author. An international journal such as *ZDM Mathematics Education* cannot accept such a narrow focus and the reviewers will usually ask for a broader view.

A strong theoretical framework is the indispensable part of a scientific manuscript. This does not need to be a framework developed by oneself; in contrast, it is nowadays usual to refer to grand theories of mathematics education developed by others, which are then narrowed down to the specific research goal of the study. It is essential to develop carefully all theoretical constructs used and to embed these constructs in the overall framework. To a certain extent, in contrast to the above remarks, one can state that it is important to focus the literature survey on the research question and avoid a too general overview of the field, only loosely connected to the research questions and aims of the paper. The balance between broadness and focus is important.

For empirical papers the methodological part of a manuscript is indispensable and quite often not satisfactory, which leads to requests for revision. The embedding of the chosen methodological approach in a research paradigm is indispensable, i.e., it must become clear to which paradigm the study is referring, to a qualitative or quantitative design, or design-based research, the mixed method paradigm, variations of the interpretative paradigm or other theoretical references. It must be convincingly explained why the chosen methodology and/or methodical approach is adequate and necessary. Especially the reflection of the adequacy of the methods is of strong importance for a high-quality paper.

Furthermore, the description of the chosen sample and sampling procedure is necessary. The description of the data evaluation process in detail can be seen as the heart of the methodological section, which is often quite poor. A short reference to a grand theory such as Grounded Theory or Text Analysis is not sufficient; in

contrast, a description of the coding structure, the development of codes and a short example is necessary to display. It is advisable to include parts of the coding manual in the appendix as well as worked out examples. These details are needed for various empirical methods, including case studies. Within the interpretative design, a careful translation of verbatim transcripts is needed, while in a quantitative design the usual quality indicators should be given. Overall, the evaluation process needs to be transparent enough for a critical reader to follow.

Many qualitatively oriented studies aim for the description of the variability of the data, which is in contrast to quantitatively oriented studies aiming for uniformity. The variability of the data should be described and should not be restricted to extremely small-scale studies.

A clear description of the results is necessary, i.e., the results should be described and discussed. In detail, interpretations referring to the original theoretical framework and the state-of-the-art of the scientific discussion should be provided. Apart from the problems mentioned above, a further problem is the missing connection between an ambitious theoretical framework and the results of study, which is caused, amongst other reasons, by the lack of intensive interpretation of the results. A connection of the achieved results and their interpretation to the theoretical framework is indispensable. However, one can state as a common mistake that an ambitious framework is used and only minor results are achieved.

Although most studies do not use representative samples the potential to generalise or to transfer to other samples or topics is important as this increases the relevance and scope of the study. Fine-grained studies are of high relevance, but at the end of the day one wishes to know how far these results hold in general or can be transferred to the context of broader research questions.

Overall, these recommendations and descriptions are not only focused on *ZDM Mathematics Education*, but on papers in mathematics educational journals in general. However, they are based on the editor's personal experience and reflect the specific features of *ZDM Mathematics Education*.

To conclude, it is hoped that *ZDM Mathematics Education* will continue to grow in its international acceptance and reach and will contribute to the further development of mathematics education as a scientific discipline.

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