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ORIGINAL ARTICLE

Hans-Georg Steiner: a life dedicated to the development of didactics of mathematics as a scientific discipline

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Abstract In our introductory paper to this special issue we follow two goals. First of all, we take on the challenge to give an account of more than 40 years of academic work by one of the leading members of our discipline by looking at Hans Georg Steiner's contributions to the development of didactics of mathematics as a scientific discipline in Germany as well as internationally. Therefore, we try to highlight major research interests, publications and conferences during his early years in Münster, Karlsruhe and Bayreuth as well as during the 20 years at the IDM in Bielefeld. Closely linked to these periods of this life and work are specific research interests, professional contacts and friendships. Hence, the second goal of our paper is to emphasise Hans-Georg Steiner's relationships with national and international colleagues (many of whom became friends) and their shared interests and collaborations in the development of mathematics education through a selection of invited papers that address different stages and professional foci in the life of Hans-Georg Steiner. These papers are organised in four sections: (1) Revisiting the New Math reform, (2) Developing specific research domains in didactics of mathematics, (3) Discussing theories of mathematics education (TME), and (4) Reflecting on goals and results of mathematics education.

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1 Introduction

This first volume of the 'new' ZDM, ''The International Journal on Mathematics Education (formerly Zentralblatt für Didaktik der Mathematik)'' now published by Springer is dedicated to Hans-Georg Steiner, who founded the ZDM together with Heinz Kunle und Emmauel Röhrl in 1969. The context of the establishment of the ZDM was the foundation of the ''Centre for Didactics of Mathematics'' at the University of Karlsruhe, which is described below.

Hans-Georg Steiner passed away on December 14, 2004 after a long illness at the age of 76. Many of us remember him as a colleague who continuously fostered ties between people as well as networks across countries and disciplines. His engagement for the development of mathematics education as a discipline nationally and internationally was extraordinary. Around the world Hans-Georg Steiner is well known for his work as one of the three founding directors of the IDM (Institute for Didactics of Mathematics) at Bielefeld University.

The editors of ZDM invited us as guest editors of this special issue ''In memoriam Hans-Georg Steiner''. The first author belonged to his working group at the IDM in Bielefeld from 1977 to 1993 and the second author was his last doctoral student. Our intention was to call for contributions from authors that represent the

various stages of his scientific life—nationally and internationally. Fortunately, many colleagues accepted our invitation to contribute to this special issue and hence helped to document the influence of his many sparks of inspiration, advice and academic stimulus for so many of us who had the privilege to meet Hans-Georg and to work with him.

The papers in this volume reflect certain stages of his scientific life. His broad research interests and his significant contributions to the development of mathematics education are also evident in the complete list of all his publications (see Appendix 1) and a list of the conferences Hans-Georg Steiner had organized (see Appendix 2). The title of this article emphasises a most important aspect of Hans-Georg Steiner's scientific life. Developing didactics of mathematics as a scientific discipline in an international perspective was a major concern of his work at the IDM and culminated in him creating the international TME movement (Theory of Mathematics Education). We intend to show how this concern has been emerging from his earlier work.

The papers in this volume are organised in four sections.

1.1 Revisiting the New Math reform

The contributions of his close friends and colleagues Heinz Griesel (Kassel), Hans-Joachim Vollrath (Würzburg) and Roland Scholz (Zürich) are directly related to Hans Georg's early research and publications. Vollrath and Griesel refer to his work related to the New Math curriculum reform in the 1960s and early 1970s, in which he played a prominent role. Scholz refers to Steiner's most favourite mathematical example, the mathematization of voting bodies. This example served as a prototype for his didactical thinking. It started as an example for making the reasons for and the value of axiomatisation in mathematics accessible to students in the 1960s. Later he used the theory of voting bodies to illustrate the social construction of mathematical knowledge (Steiner, 1969b, 1983).

1.2 Developing specific research domains in didactics of mathematics

Hans-Georg Steiner's work at the IDM in Bielefeld is reflected in papers addressing specific research topics and working contacts from that time at an international level through the papers by Mariolina Bartolini-Bussi (Modena), Gila Hanna and Nathan Sidoli (Toronto) and Gilah Leder (Melbourne) as well as contributions from the former IDM members Hans-Niels Jahnke (Essen), Heinz Steinbring (Essen) and Gerd Schubring (Bielefeld).

1.3 Discussing theories of mathematics education

In their papers, Luciana Bazzini (Turin), Juan Godino, Carmen Batanero and Vicenç Font (Granada/Barcelona), Colette Laborde (Grenoble), David Tall (Warwick) as well as Günter Törner and Barath Sriraman (Duisburg/Montana) address aspects of Hans-Georg's latter research interest in what he called TME, i.e. theory of mathematics education.

1.4 Reflecting on goals and results of mathematics education

During his entire life, Hans-Georg Steiner was concerned about the goals and results of mathematics education. Therefore, this special issue would have been incomplete without the contributions of Ubiratan D'Ambrosio (Sao Paulo), Rudolf Sträßer (Gießen/Luleå) and Shlomo Vinner (Beer Sheva), who look at this aspect from didactical, political, social and philosophical perspectives.

In our introduction to this special issue we aim to shine a light on Hans-Georg Steiner's approaches, challenges, co-operations and achievements in his strive for a an international reform of mathematics teaching and learning. In doing so, we pay our respect to our academic teacher who supported not only our professional careers but who was also highly influential to many other teachers and researchers in Germany and across the globe as the papers in this volume highlight.

2 The early years: Münster–Karlsruhe–Bayreuth

Hans-Georg Steiner, born on the 21st November 1928, was 16 years old when World War II ended in Germany. He suffered from being among those children that the criminal Nazi regime forced to become a member of the anti-aircraft protection forces in the last stages of the war. After the war, he completed his school education under the difficult conditions of post-war Germany (for a detailed account see Steiner, 1998). In 1949 he enrolled in mathematics and physics at the University of Münster. From his first days at university on he showed a great interest in other subjects as well and was an active participant in lectures and seminars on linguistics and literature, philosophy and pedagogy. In 1955 he graduated with his first teacher state exam followed by the second teacher state

exam in 1957. In the following 2 years he worked as a research assistant of Heinrich Behnke at the Institute of Mathematics in Münster where he was responsible for the programme and content of the seminars on the didactics of mathematics held every Tuesday afternoon.

Heinrich Behnke, a leading German mathematics professor of international renown at the University of Münster had a distinguished interest in didactics. He soon realised the potential of the young Steiner and involved him in the organisation of conferences while he still was an undergraduate student. The series was called ''Tagung zur Pflege des Zusammenhangs zwischen Höherer Schule und Universität'' [Münster Conferences for the Furtherance of the Connection between School and University] (Conference 1[1]). In 1957—while still completing the second phase of teacher training—he was invited by Behnke to give a lecture at this conference. The other speakers were renowned university professors in mathematics or natural sciences and gave seminars on recent results of their disciplines. Only Hans-Georg Steiner explicitly pointed out relationships between university and school level. His eloquence, outspokenness and his distinguished style of presentation had already become evident. The title of his lecture ''The introduction of modern mathematical concepts to the mathematics classroom'' [Der Eingang moderner mathematischer Begriffe in den Schulunterricht] attracted many regional grammar school teachers. According to Griesel (1988, p. 167), Steiner's audience was divided. Some questioned his authority being 'only' a young not yet experienced teacher, having visions not backed-up by practical experience whereas others anticipated that they were being witnesses of a prelude of a new upcoming reform.

The lecture was published as an essay (Steiner, 1959) which was later considered a key contribution to the reform of secondary mathematics education in Germany (Knoche, 1988). It provided the starting point for an extensive sequence of papers and publications on theoretical as well as classroom based topics in the field of mathematics education. The ''engine of the reform'' (Griesel, 1988) had started to run and ran for more than a decade. This start was courageous, ambitious and polarizing—however, not the last event of this kind in his life.

A major goal and means of improving mathematics education was the elementarization of modern concepts of mathematics as a science, making it accessible to a wide range of primary and secondary students. This reform movement was already internationally growing and it later gained in power because it met favourable societal and political conditions supporting educational reforms in general and not only in mathematics. In western countries the so-called 'Sputnik shock' had initiated an enormous concern and investment into the educational systems.

For envisioning the congenial intellectual and cultural climate, let us remember Jerome Bruner's enormously influential principles of curriculum reform in those days, which came out of the legendary Woods Hole Conference on Cape Cod in 1959: ''We begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development'' (Bruner, 1960, p. 33). Additionally, Bruner advocated the structure of the discipline as a basic orientation for all science-based school reforms and saw the spiral curriculum principle as a way to make this work.

Hans-Georg's extensive international involvement already started at a time when he still was an undergraduate student. The International Commission of Mathematics Instruction (ICMI) had reconstituted itself as part of the International Mathematical Union (IMU) after World War II in 1951. Heinrich Behnke became a member of ICMI's international executive committee, was its president from 1954 to 1958 and served as the president of the German subcommittee from 1951 to 1966. While collaborating with Behnke, Hans-Georg Steiner became involved in the ICMI activities and in 1962 he became a member of the German ICMI subcommittee himself.

In the course of the ICMI subcommittee meetings, which took place under the leadership of Heinrich Behnke at the University of Münster, Steiner met teachers and researchers interested in pedagogy, philosophy and didactics—the basis for intensive working contacts as well as personal friendships, for example with Heinz Griesel, Günter Pickert and Hans Freudenthal. It is important to note that the German Association for Didactics of Mathematics was founded not earlier than 1975 and that the German ICMI subcommittee had an important institutional function in the emerging discipline of didactics of mathematics in Germany.

While working with Heinrich Behnke, Hans-Georg Steiner attended his first international congress in 1958—the International Mathematics Congress (ICM) of the International Mathematical Union (IMU) in Edinburgh, Scotland, where he met a number of leading US American curriculum reformers. These initial contacts were further established at the ICM

[1] The conferences that Hans-Georg Steiner organized are listed in Appendix 2 of this article. We refer to the list by Conference *number*).

1962 in Stockholm and the ICM 1966 in Moscow, where Steiner was invited to give a keynote address titled ''The role of axiomatics in mathematics teaching''.

In 1960 Hans-Georg Steiner made the first of many journeys to the United States being invited to give lectures in a summer institute for mathematics teachers at Columbia University in New York. This first professional journey to the USA was followed by another series of invited lectures and workshops at several teacher colleges and universities across the country sponsored by the American Association for the Advancement of Science (AAAS). The result of these journeys was a developing cooperation with US American curriculum projects: the ''Secondary School Mathematics Curriculum Improvement Study'' (SSMCIS) founded at Columbia University and the ''Comprehensive School Mathematics Program'' (CSMP) initiated by Burt Kaufmann and supported by the ''Central Midwestern Regional Educational Laboratory'' (CEMREL) in St. Louis, Missouri. Hans-Georg Steiner became the European co-director of the CSMP, which was dedicated to the development of an enhancement program for mathematically gifted students. A number of publications between the years 1967 and 1973 document the intensive and fruitful work of these two projects. Hans-Georg's key talents—initiating, fostering and extending international relationships in the field of didactics of mathematics—were already becoming evident. His work as an initiator and connector was continued and further intensified during his many years as director at the ''Institute for Didactics of Mathematics'' (IDM) at the University of Bielefeld (see below).

Parallel to his international activities, Hans Georg Steiner's involvement and responsibilities at the ''Seminar for Didactics of Mathematics'' in Münster, where he closely cooperated with Heinz Griesel, included an increasing number of invitations of interested colleagues and researchers from various countries in Europe and abroad. Quite frequently these guests together with close friends were invited to his home where he and his wife, Erika-Luise, hosted them in a most kind, charming and stimulating atmosphere. Their hospitality and generosity was greatly appreciated back then as well as later in Bielefeld by many members of our community. The special atmosphere of these visits as well as during meetings at many conferences was greatly influenced by his wife who actively took part in the discussions and contributed her personal views on didactical topics which were based on a genuine interest in the development of mathematics education and a great respect for and interest in scientific discourse in general.

But not only his nurturing of international contacts was legendary. Hans-Georg Steiner also enriched the Münster seminar series by many thought provoking presentations and topics. Behnke acknowledged his multi-faceted contributions in a documentation of the work of the didactical seminar in 1971 as follows: ''H.-G. Steiner was the one who provided the most colour and innovation to the seminar. His personal academic development and that of the seminar was frequently inseparable.'' [Am meisten Farbe und Neuerungen hat H.-G. Steiner dem Seminar geliefert. Seine eigene Entwicklung und die des Seminars liefen manche Jahre völlig synchron.] (Behnke, 1971).

School related publications during this time address

- the teaching of logic in middle and high school,
- the role of algebraic games for the understanding of algebraic structure,
- the teaching of equations and functions, as well as
- the teaching of geometry.

Several of these publications were fundamental analyses of lasting value. In 1964 and 1965 Hans Georg Steiner published two papers on a correspondence between Frege and Hilbert, which he commented on in great detail. The reform of the construction of the number system in reference to Frege is also the topic of a paper by Heinz Griesel in this volume in which he argues that Steiner's point of view on the construction of the number system offers great potential for school mathematics (Steiner, 1964, 1965).

Teaching experiments and didactical analyses on the topic of mathematization of political structures were a major focus of his mathematical as well as didactical work in the late 1960s and 1970s. Hans-Georg Steiner's ''Mathematical Theory of Voting Bodies'' [Eine mathematische Theorie von Abstimmungsgebilden] was also the core of this doctoral thesis completed 1969 at the University of Darmstadt with Detlef Laugwitz (Steiner, 1969a). Roland Scholz takes on and elaborates on the topic of voting bodies in his contribution to this special issue while Hans-Joachim Vollrath describes the historical context and Steiner's previous controversy with Laugwitz in the context of the New Math reform.

Two years prior to his doctoral degree, Steiner took on a position at the University of Karlsruhe at the newly established Department for Didactics of Mathematics at the Institute of Geometry run by the mathematician Heinz Kunle, who—like Behnke—was greatly interested in fostering the didactics of mathematics. In 1970, Heinz Kunle became the president of the German ICMI subcommittee, a position he retained until 1990. In Karlsruhe—the later location of

ICME 3—Steiner succeeded in the foundation of the ''Zentrum für Didaktik der Mathematik'' [Centre for Didactics of Mathematics]. This new centre was connected through intensive working contacts and co-operations to the CERMEL in St. Louis, Missouri. The foundation of the ''Zentralblatt für Didaktik der Mathematik'' (ZDM)—the first truly international journal on the didactics of mathematics to be established in Germany—followed in 1969 and for the coming decades Steiner remained its co-editor. The creation and development of an extensive international database with refereed publications on mathematics education (MathDi, MathEduc, http://www.emis.de:80/MATH/DI.html) was part of this process. Gerhard König became the managing editor.

In May 1970 Hans-Georg Steiner was appointed as full professor of a new chair in mathematics education at the Educational University in Bayreuth, Bavaria, but maintained the leadership of the ''Centre of Didactics of Mathematics'' in Karlsruhe. In 1971, he organized the ''5th Annual German Conference on the Didactics of Mathematics'' in Bayreuth and internationalized the conference by inviting colleagues such as Anna Zofia Krygowska (Poland), Tamás Varga (Hungary), Hans Freudenthal (The Netherlands), Georges Papy (Belgium) and Bent Christiansen (Denmark), who had been influential in the international reform movement of mathematics education.

3 Institut für Didaktik der Mathematik (IDM), Bielefeld 1973–1993

3.1 Overview

In spring 1973, Hans-Georg Steiner received an offer to become one of the three directors of the newly founded ''Institut für Didaktik der Mathematik'' (IDM). He accepted the offer in the fall of 1973 and served as a director of the IDM together with his colleagues Heinrich Bauersfeld and Michael Otte until he retired in 1993. The IDM was founded as a central research institute for the didactics of mathematics in Germany. Its responsibilities included the development of didactics of mathematics as a scientific discipline comprising the establishment of a national and international scientific network of scientists.

Apart from the unit for documentation and library led by Gert Schubring, the IDM mainly consisted of three working groups called F1, F2, and F3, which were directed by its three professors. ''F'' originally stood for ''flexible working unit''. It turned out, however, that these groups became quite a stable structural element of the IDM. In the course of IDM's development the subtitles of the groups also developed due to shifts in research interests. Nevertheless, collaboration at the IDM went beyond the borders of the working groups and two former members of F2, Hans-Niels Jahnke and Heinz Steinbring, as well as Gert Schubring, with whom Hans-Georg Steiner shared common interests in the history of mathematics and mathematics education, have contributed to this volume.

F3 started as the ''Working Group for Mathematics Education at Upper Secondary Level'' (i.e., grades 11–13) and this remained one of its major domains of interest at least for about the first decade of its existence. The group had an interdisciplinary character. Members had different backgrounds in mathematics, mathematics education, psychology, sociology and educational science (see Sect. 3.1).

The foundation of the ZDM, the IDM and similarly the IPN [Institute for the Pedagogy of the Natural Sciences] in Kiel can be regarded as the establishment of 'excellence centres' that were intended to develop scientific disciplines within a new concern for science as an engine for social and economic development. All industrialized societies increased their investments in education enormously in the late 1960s and 1970s. The ''scientification'' of society called for new science-based educational approaches. Didactics was not confined to optimize teaching and learning processes in school but also regarded as a reflective science concerned with knowledge in society.

When Hans-Georg Steiner started his work at the IDM, he was part of the emerging mathematics education community in Germany with whom he shared the co-operation, the visions and the disappointments in the process of the New Math reform movement. Together with German colleagues he continued to collaborate in the editorial board of three German journals for mathematics education ''Mathematisch–Physikalische Semesterberichte'', ''Didaktik der Mathematik'' and ''Zentralblatt für Didaktik der Mathematik''. He had played an early role in founding the latter two journals.

The early IDM assisted in the process of preparing ICME 3 in Karlsruhe in 1976, where Hans-Georg Steiner chaired the International Programme Committee (IPC) and Heinz Kunle chaired the Local Organizing Committee. Hans-Georg had already been a member of the IPC of ICME 1 in Lyon 1969 and ICME 2 in Exeter 1972. He had an enormous influence on the scientific structure of the 1976 congress. A major outcome of the congress was the book ''New Trends in Mathematics Education'' (Christiansen and Steiner, 1979), which was published and disseminated

by UNESCO in addition to the proceedings (Athen and Kunle, 1977). Other than traditional proceedings with many single papers the book contains 13 chapters with survey reports attempting to summarize and identify major trends in mathematics education. These chapters were based on group work that started one year before the congress. Hans-Georg Steiner continued his collaboration with UNESCO and shared with this organization the goal of the global development of mathematics education as a practice as well as a scientific discipline with a clear responsibility of the developed countries for the developing ones.

Fig. 1 H.-G. Steiner at a conference in Oberwolfach in December 1975

Together with Benno Artmann and Arnold Kirsch, Hans-Georg Steiner had been the editor of the book series ''Moderne Mathematik in elementarer Darstellung'' published by Vandenhoeck and Ruprecht in Göttingen. The title of this series ''Modern Mathematics in an Elementary Exposition'' stands for its program, namely supporting teachers and teacher educators with elementarized modern mathematics. Volume 22 of the series was published in 1988 on the occasion of Hans-Georg Steiner's 60th birthday. It was edited by Hans-Joachim Vollrath and contained reprints of eight of Steiner's papers (Vollrath, 1988). The deliberate focus was Steiner's contributions to the New Math reform (six papers from the 1960s). It further contained his 1976 paper on mathematization and a paper about philosophy and mathematics (Steiner, 1976a, 1985). The latter papers tentatively indicate a shift of his scientific interests and scientific networks, which had taken place during his work as a director of the IDM since 1973. This is also evident from the programmatic title of a new book series starting 1985 with Vandenhoeck and Ruprecht that he edited together with Michael Otte (IDM Bielefeld) and Ivo Schneider (München) called ''Studien zur Wissenschafts-, Sozial- und Bildungsgeschichte der Mathematik'' [Studies on the social, scientific and educational history of mathematics].

Hans-Georg Steiner fertilised the IDM with his broad international contacts and cooperations, which he extended and deepened over 20 years. Many young as well as already well-established international researchers visited the IDM. Hans-Georg was eager to communicate and popularize research results of all working groups of the IDM to a wide national and international community (see Sect. 3.3). He motivated and actively supported young researchers in the IDM and beyond to build and foster their international relations. Both authors of this paper are very grateful to him for his encouragement and assistance in this respect.

His international relations also were of great assistence when the IDM slipped into an existence crisis around 1991–1992. The national and international support for the IDM is documented in an IDM-Occasional Paper (Steiner, 1992).

In honour of his 60th birthday, Heinz Griesel (Kassel) and Roland Fischer (Klagenfurt) edited a special issue of ZDM (Griesel and Fischer, 1988). Griesel's (1988) and Fischer's (1988) papers on Hans-Georg Steiner as ''the engine of reform'', respectively, ''the engine of networking'' pointedly characterize him before and after joining the IDM. Norbert Knoche (1988) in his homage concentrated on Hans-Georg Steiner's early years and also described his later shifts of interest. More related to his IDM years, a collection of papers from a colloquium on the occasion of his birthday was also published (Winkelmann, 1988).

However, a stable interest and characteristic feature of Hans-Georg Steiner was his integrated understanding of mathematics teaching, didactics of mathematics, research and society that Fischer (1988, p. 171) characterizes as dynamic-procedural and open, pluralistic-integrative, connecting content and social aspects as well as theory and practice. This inclusive view of mathematics and its teaching and learning influenced and was obviously shared by colleagues around the world as the two papers by Ubiratan D'Ambrosio from Brazil and Shlomo Vinner from Israel in this volume indicate.

From 1984 onwards, his interest in developing and structuring the discipline of mathematics education let him create a series of international conferences and cooperations under the title of TME—''Theory of Mathematics Education'' (see Sect. 3.4). Hans-Georg Steiner's 65th birthday and retirement coincided with

IDM's 20th birthday, which gave rise to the volume ''Didactics of Mathematics as a Scientific Discipline'' edited by the four core members of his working group ''F3'' at the IDM at that time (Biehler, Scholz, Sträßer, & Winkelmann, 1994).

3.2 Working group F3: mathematics education at upper secondary level

Hans-Georg Steiner's scientific activities related to mathematics education at upper secondary level are less well known than his outstanding contributions to the New Math reform movement and to related theories of mathematics education. The German upper secondary level consisted of two major strands. The Gymnasium [grammar school] was supposed to provide ''higher general education'' for those students intending to go to university. Vocational schools, which were attended by more than 75% of the students, were supposed to provide vocational education including components of higher general education.

The gap between vocational schools and general education at the Gymnasium was large, and the federal state of North-Rhine-Westfalia established a large model project [Modellversuch Kollegschule], where new types of schools were founded that were supposed to create curricula with the intention to combine general and vocational education. A central aim of these schools was to improve social mobility and contributing to participatory democratic education. Moreover, mathematics became part of the cluster mathematics/computer science/philosophy and relations between these subjects had to be reflected in the curricula. Hans-Georg Steiner became the scientific advisor for mathematics in this model project and regarded vocational education as part of the domain of his research group on upper secondary education. Rudolf Sträßer became a member of Steiner's group at the IDM and his major responsibility was mathematical education in vocational schools (see his contribution to this volume).

In his engagement in the New Math reform movement in the 1960s, Hans-Georg Steiner had contributed many papers with didactically oriented subject matter analyses [stoffdidaktische Analysen]. His relations to the reforms of the late 1970s, however, were partly more indirect, critical, moderating, analytical and reflective than directly constructive by means of providing teaching examples, didactical analyses or didactical visions.

His evaluation of the failure of the somewhat top down New Math reform in the 1960s led him to two major consequences: recognizing a need for more fundamental research and a recognition of mathematics education from a systems perspective, including the school system, the teacher education system and didactics of mathematics at university level.

Hans-Georg Steiner became convinced that any curriculum development has to be based on fundamental research addressing questions such as

- What is mathematics, what is mathematical thinking?
- What is the role of mathematics in other sciences or in society, for people in everyday life and at their workplace?
- What were determinants of the development of mathematical curricula in the past?
- What are conditions for innovation in educational systems?
- What knowledge of mathematics and of didactics of mathematics do teachers need?
- How can mathematics education contribute to the general goals that were set up for education at upper secondary level?
- How can goals for mathematics education be justified?

These fundamental questions were related to the Zeitgeist of those years and of the IDM in particular: people felt the need for a deeper research base for supporting a scientification of the practice of curriculum design, development, implementation and evaluation.

Although one will hardly find any empirical study among Steiner's publications, this does not imply that he was not aware of the importance of empirical research in our discipline. On the contrary, several of the young researchers that he had recruited for his group had backgrounds in empirical pedagogy and psychology, among others Roland Scholz (see his contribution to this volume as well as Scholz, 1987, 1991). Hence studies on students' and teachers' thinking and on empirical curriculum research became part of F3's work.

The concrete educational context, in which the working group F3 was situated, was a national agreement between all West German federal states that had been achieved in 1972. It concerned an organizational and curricular reform of upper secondary education for all subjects. A certain specialization and differentiation of students should already start in grade 11. In two major elective subjects, the students were to learn subject matter specific scientific thinking similar to what would later be practised at university. In their minor subjects, basic scientific education [wissenschaftliche Grundbildung] was the objective. An important completely new organizational consequence was that

mathematics had to be taught under very different boundary conditions: as an advanced course [Leistungskurs] or as a basic course [Grundkurs]. New curricula, text books and pedagogical approaches had to be developed. This new situation presented a great challenge for curriculum development, for research, and for the development of new didactical theories of upper secondary mathematics education.

While aiming to design a more fundamental research approach, Steiner and his group intended to give partial answers, influence the actual developments and develop a network of co-operation. A series of conferences was organized on the situation of teaching calculus and linear algebra (Conference 10), on didactics of mathematics in the education of future teachers (Conference 12) (Steiner, 1976b), general questions of mathematics education at upper secondary level (Conference 13), and specific topics such as the relation of mathematics education to philosophy (Conference 15) and information technology (Conference 14). Public interventions concerned the ''Normenbuch'', i.e., the examination standards for upper secondary final examinations (Conference 9) (Luschberger, Steiner, Stowasser, & Winkelmann, 1975), and a profound critique of a public appeal by scientific organizations (including MNU and DMV) with the title ''Save the quality of mathematics and science education'' [Rettet die mathematisch-naturwissenschaftliche Bildung] (Steiner, 1982, 1984). Hans-Georg Steiner's group F3 initiated the DIMGO-Project concerned with differentiation at upper secondary level, which was externally funded. It aimed at empirically researching the state of the art of basic and advanced courses in mathematics by means of analyses of curricula and textbooks, a representative survey of mathematics teachers as well as visits to exemplary classrooms (Conference 20) (Peschek & Steiner, 1982; Pfeiffer & Steiner, 1981; Reiss & Steiner, 1984). The dissertation of Hermann Pfeiffer on the social organization of knowledge in upper secondary mathematics teaching, which Hans-Georg Steiner supervised, was embedded into this work (Pfeiffer, 1981). Subsequently, Steiner's as well as his group's attention turned to the development of mathematical competencies at upper secondary level and a collaboration with psychologists and the group of Willibald Dörfler and Werner Peschek in Klagenfurt was established (Conference 22, 25) (Steiner, 1986).

The visible part of Hans-Georg Steiner's year long co-operation with the 'Kollegschulversuch' were two conferences (Conference 14, 15) (Steiner, 1977) and some papers concerning philosophy and mathematics education, an interest that had emerged already during his studies in Münster and that was revived when a coordination between philosophy and mathematics curricula in the Kollegschule was put on the agenda. The focus of the second conference in September 1977 was on the relation between mathematics and information technology. Although the use of technology is not addressed in his publications, Hans-Georg regarded research in this domain as a responsibility of the IDM. He supported pertinent research and development in his working group F3 very early (see e.g. Biehler, Rach, & Winkelmann, 1988; Biehler & Winkelmann, 1988; Winkelmann, 1982) and advocated in vain that a vacant professorship at the IDM should be devoted to technology in mathematics education. The first ICMI study was devoted to the influence of computers in mathematics education and the study conference took place in Strasbourg 1985. Not only did he initiate a German preparatory conference for this study in the Mathematical Research Centre in Oberwolfach in fall 1984, but also the majority of his working group attended the conference (Biehler, Sträßer, & Winkelmann, 1986). For all three group members, research and development related to the use of technology in mathematics classrooms became a major focus of their research at a later stage. Furthermore, the contact to David Tall was established through this conference in Strasbourg (see the paper by Tall in this volume).

Hans-Georg Steiner's engagement and support of vocational education went beyond the consultancy for the Kollegschule model project. Together with Rudolf Sträßer he succeeded in attracting financial support for a project that focussed on curriculum development and research for vocational schools (Steiner & Sträßer, 1980, 1981; see also Rudolf Sträßer's contribution to this volume).

From about the mid 1980s onwards, Steiner's scientific focus on upper secondary mathematics education diminished and he put his energy into developing the international TME program and into fostering collaboration in didactics of mathematics in Germany. The members of his group developed and elaborated their own fields of research and scientific networks. Despite this growing diversity, the personal collaboration, co-operation and mutual encouragement in his group F3 functioned well. While Hans-Georg Steiner did not make his working group at the IDM a 'scientific school' in the sense of a concise shared focus on methods and scientific objects, his extremely broad knowledge, overview and theoretical interests in the didactics of mathematics as well as his liberal personal and scientific attitude resulted in a working environment, where individual specialization and development was possible and strongly supported.

3.3 Internationalization

As has been expressed earlier, Hans-Georg Steiner supported and co-shaped the international relations of the IDM and worked for the aim of making German didactics of mathematics as a whole internationally visible and competitive. Among other institutes, the IDM was founded to develop international relations, therefore time and financial resources were available for this purpose. The conferences which Hans-Georg organized show only the most visible part of these activities. In the early years, co-operations with UNESCO and ICMI, whose vice-president he was from 1975 to 1978, were supportive of these activities.

Nowadays, when TIMSS and PISA have become very influential in educational policy (at least in Germany) it seems relevant to remember that in a certain respect, Steiner became involved in the ''Second International Mathematics Study'' (SIMS) (http://www.iea.nl/sims.html). Germany, however, did not participate in SIMS for reasons unclear to the authors of this paper.

The ''First International Mathematics Study'' had been criticized severely by Freudenthal (1975) and others with regard to curricular validity and the comparability of results. As part of SIMS and as a consequence of the critique on FIMS a broad comparative study of curricula was initiated and Steiner invited representatives of many countries, SIMS researchers and curriculum researchers to a conference on ''Comparative Studies of Mathematics Curricula—Change and Stability 1960–1980'' (Conference 18) and also to conferences of related topics (Conference 19, and later Conference 29), where the topic was not only discussed from the SIMS perspective but also from a more fundamental point of view of research on curriculum change (Steiner, 1980). The subtitle of the first conference was ''From Royaumont to Ohrbeck''. The seminar on ''New Thinking in School Mathematics'' had taken place in Royaumont near Paris in September 1959 (OECD, 1961) and was considered as the signal event for the world-wide New Math reform in the 1960s (also famous for Jean Dieudonné's legendary ''Euclide must go'' lecture). While the subtitle may sound a little bit overambitious today, it highlights the intention to create a science-based approach to curriculum development trying to learn from the failures of the past. Importantly, research on curriculum change and on curricular innovation was to become a research domain of its own.

With regard to a more active participation, a certain reservation against studies such as SIMS and later TIMSS was persistently shared in the IDM in those days.

Another large conference in the early years of Hans-Georg Steiner's work at the IDM was the conference on ''Co-operation between Science Teachers and Mathematics Teachers'' in 1978 (Conference 17), which was organized in co-operation with ICMI and UNESCO. This conference—originally planned for developing joint teaching units—was partly transformed by him into a research conference that also discussed social and epistemological conditions for co-operation (Steiner, 1979).

From 1986 until 1992 Hans-Georg Steiner organized a series of bilateral conferences with Italian colleagues (Conference 33, 40) together with Luciana Bazzini (Bazzini & Steiner, 1989, 1994), with French researchers together with Colette Laborde (Laborde, 1988) (Conference 28) (see the contributions by Bazzini, Bartolini-Bussi and Laborde in this volume) and with colleagues from former Czechoslovakia (Conference 32, 36). He attracted financial support for these conferences from the German Research Foundation (DFG) and the respective research foundations in the other countries. At the time of writing, as we look forward to the 5th ''Congress on European Research in Mathematics Education'' (CERME), European scientific exchange has become well-developed. In the 1980s this was not yet the case.

Fig. 2 H.-G. Steiner at a conference in Karlovy Vary in 1988

3.4 Theory of mathematics education (TME)

In his activities and papers on TME, Hans-Georg Steiner convincingly argued for an interdisciplinary

and transdisciplinary approach to the didactics of mathematics integrating the philosophy and history of mathematics, subject matter specific didactical analyses, curriculum research, research from cognitive psychology and theories of teaching and learning (Steiner, 1987, 1988). He aimed at structuring the discipline and at clarifying the relationships to other disciplines. A visible trace of Hans-Georg's initiatives are the five TME conferences he organized between 1984 and 1991 (Conference 24, 26, 30, 35, 39) and his many related publications (e.g. see Steiner & Vermandel, 1988; Vermandel, 1988). We have already pointed out that his interest in this domain originated much earlier and was also related to the institutional function of the IDM.

Hans-Georg Steiner's work is still influential and has been re-discovered in recent work as Törner and Sriraman describe in their contribution to this volume. The need for a meta-scientific framework for structuring, classifying and orienting the fast growing body of research in mathematics education is of ongoing relevance. The holistic and comprehensive approach that Hans-Georg Steiner courageously attempted to realize may have been historically ahead of its time. Nevertheless, we are missing his overall perspective. At the time of writing, producing scientific results in concise domains or relating research too closely to current political developments in the educational system is more en vogue than reflecting on our discipline's development. Hans-Georg not only argued for the need for this reflection. He saw meta-scientific reflection as a difficult but crucial research duty of the community itself. This can be considered as one of the legacies of Hans-Georg Steiner's work, which hopefully will influence the future development of our discipline.

The conferences as such and Hans-Georg's related activities often functioned as a catalyst and encouragement of theory-aware developments and active involvement in shaping didactics of mathematics as a scientific discipline (see Gilah Leder's contribution to this volume). The contribution of Gila Hanna, who was invited by Steiner to stay at the IDM for some weeks in the 1980s, is one of the many cases, where networks were established and elaborated (see her paper together with Nathan Sidoli in this volume). David Tall, in this volume, exemplarily describes how a visit at the IDM stimulated his theoretical orientation and Juan Godino, Carmen Batanero and Vicenç Font describe Hans-Georg's influence on the emergence of theoretical approaches in the didactics in Spain. In 1994, Batanero, Godino, Steiner and Wenzelburger (1994) had documented international activities concerning the training of young researchers in mathematics education, where an overall perspective of TME is essential. However, although there had been long lasting discussions about establishing a postgraduate study program at the IDM itself, the decision patterns and processes were too complex for that it was realized in time.

3.5 Buildings networks and supporting research collaboration in German didactics of mathematics

Concurrently to elaborating the TME program, Hans-Georg Steiner aimed at supporting research collaboration in German didactics. Together with Heinrich Winter, who at that time was the president of the ''Gesellschaft für Didaktik der Mathematik'' [''Association for the Didactics of Mathematics'' in German speaking countries], he organized two conferences on the relationship between didactics of mathematics and history of education and science (Conference 23, 27) (Steiner, 1990; Steiner & Winter, 1985). Later, two conferences were particularly devoted to scientific exchange and collaboration between young German researchers of that time (Conference 37, 41) (Steiner & Vollrath, 1995).

A specific concern of Hans-Georg Steiner was the promotion of co-operation between West German and East German mathematics educators. Even before the fall of the Berlin wall in 1989, Steiner managed to establish some relations with colleagues from East Germany. Soon after the border between the two German countries was open, he began to plan the first ''German-German-Bilateral Conference on Didactics of Mathematics''. This fits well into his series of bilateral conferences with mathematics educators from Italy, France, and Czechoslovakia. However, it turned out that the German reunification process ran faster than the conference preparation. The conference took place in October 21–28, about three weeks after the 3rd October 1990—the day of the German reunification (Conference 37). Unfortunately, Hans-Georg had to go to hospital in the week of this conference and Bernard Winkelmann and Rolf Biehler took over responsibility and chaired the conference.

Hans-Georg Steiner resumed his interest in fostering East-West-German collaboration after his retirement. In 1996, he organized a double conference together with Werner Walsch (Conference 42) reflecting on the very different developments of didactics of mathematics in both parts of our country. His encroaching illness overshadowed the production process of the proceedings. In the early 2000s Peter

Bender and Herbert Henning took over as editors, and on the occasion of his upcoming 75th birthday the proceedings (Henning & Bender, 2003) dedicated to Hans-Georg, were presented to him. At that point in time the consequences of his severe illness had already taken its toll. Fortunately, he had communicated to his wife early enough his wish that his library with numerous books, papers, journals and materials covering four decades of mathematics education be left to a university in one of the new federal states that used to belong of the former German Democratic Republic, in order to support the education of young teachers and researchers in the new states. Today, the Martin-Luther-University in Halle-Wittenberg, in particular our colleague Wilfried Herget, is taking care of this legacy.

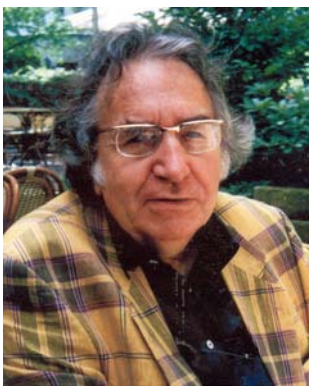

Fig. 3 In summer 2003 when he was presented the proceedings edited by Henning & Bender

Acknowledgments We would like to express our heartfelt thanks to a number of persons who have supported and encouraged us during the preparation of this special issue. This volume would not have become reality without Gabriele Kaiser, the editor-in-chief of the journal. While the idea of a special issue ''In memoriam Hans-Georg Steiner'' had been raised independently by several colleagues and friends and was approved by the advisory committee of the ZDM, Gabriele took up and strongly supported this idea. She provided a great deal of assistance (and sometimes pressure) during the last 15 months. Her constant optimism and quick reactions to our many questions and ideas were invaluable and are greatly appreciated.

Our sincere thanks also go to Herta Ritsche, the former secretary of Hans-Georg Steiner and his group F3 at the IDM in Bielefeld. She had maintained a fairly accurate and comprehensive list of his publications on a disk in an old MacIntosh format, which, however, was no longer readable—not even by new Mac computers. Fortunately, not all old Macs had disappeared from the IDM so that the file could be recovered eventually. Herta was also a great support in our attempt to update and complete this list in order to make it available to the readers of this journal in a unified format.

We are also very grateful to Roland Scholz, Rudolf Sträßer, Gabriele Kaiser and to Michael Koop for their constructive and supportive comments on earlier versions of this paper. While their comments were extremely helpful, we would like to stress that the authors take full responsibility for the content of this paper.

We extend our special thanks to Erika-Luise Steiner. She not only opened her private photo albums for us, but her lively reports about her husband's involvement in mathematics education conferences around the world (many took place at a time when both of us were still students at school/university) provided a lot of background information for this article. On behalf of the mathematics education community we would also like to express our thankfulness and appreciation for her continued support of her husband over many decades in a personal as well as in a professional sense. She shared with him many conferences and events, discussed papers and politics with him and was a charming host for many meetings at their home. Erika-Luise Steiner certainly made the most important invisible contributions to Hans-Georg Steiner's scientific achievements.

Last but not least, we cordially thank all authors who contributed to this special issue. They all shared our enthusiasm for this project and with their contributions helped to highlight the influence that Hans-Georg Steiner had on their work and on the development of the didactics of mathematics as a scientific discipline.

Appendix 1

List of Hans-Georg Steiner's Publications

1. Steiner, H.-G. (1956). Bewegungsgeometrische Lösung einer Dreieckskonstruktion. *Mathematisch-Physikalische Semesterberichte, 5* (1/2), 132–137.
2. Behnke, H. & Steiner, H.-G. (1956a). Der Begriff des Vektors in der wissenschaftlichen Literatur. Teil 1. *Der Mathematikunterricht*, 2 (1), 5–23.
3. Behnke, H. & Steiner, H.-G. (1956b). Der Begriff des Vektors in der wissenschaftlichen Literatur. Teil 2. *Der Mathematikunterricht*, 2 (4), 65–92.
4. Steiner, H.-G. (1957). Einführung in die Relationstheorie. *Mathematisch-Physikalische Semesterberichte, 5* (3/4), 261–271.
5. Pickert, G. & Steiner, H.-G. (1958). Komplexe Zahlen und Quaternionen. In H. Behnke et al. (Eds.), *Grundzüge der Mathematik I* (pp. 469–497). Göttingen: Vandenhoeck & Ruprecht.
6. Steiner, H.-G. (1959). Das moderne mathematische Denken und die Schulmathematik. *Der Mathematikunterricht, 5* (4), 5–79.
7. Steiner, H.-G. (1959/60). Das Turmproblem als Veranschaulichung der Divergenz der harmonischen Reihe. *Der mathematisch-naturwissenschaftliche Unterricht, 12* (5), 224–225.
8. Steiner, H.-G. (1960). Eine statische Deutung gewisser unendlicher Reihen. *Mathematisch-Physikalische Semesterberichte, 7* (1), 101–107.
9. Freudenthal, H. & Steiner, H.-G. (1960). Gruppentheorie und Geometrie. In H. Behnke et al. (Eds.), *Grundzüge der Mathematik II* (pp. 403–421). Göttingen: Vandenhoeck & Ruprecht.

10. Steiner, H.-G. (1960/61). Ist ein Produkt Null, so ist wenigstens ein Faktor Null. *Der mathematisch-naturwissenschaftliche Unterricht, 13*, 408–412.
11. Behnke, H. & Steiner, H.-G. (1961). Der Mathematikunterricht und die Hochschulreife. *Mathematisch-Physikalische Semesterberichte, 7 (2)*, 213–223.
12. Steiner, H.-G. (1961a). Logische Probleme im Mathematikunterricht: Die Gleichungslehre. *Mathematisch-Physikalische Semesterberichte, 7* (2), 178–207.
13. Steiner, H.-G. (1961b). Ansatzpunkte für logische Betrachtungen und Übungen im Unter- und Mittelstufenunterricht. *Der Mathematikunterricht, 7* (1), 79–112.
14. Steiner, H.-G. (1962a). Elementare Logik und Wahrscheinlichkeitstheorie. *Der Mathematikunterricht, 8* (1), 16–38.
15. Steiner, H.-G. (1962b). Die Verbindung von Logik und Mathematik im mathematischen Unterricht. *Mathematisch-Physikalische Semesterberichte, 9* (1), 74–95.
16. Steiner, H.-G. (1962c). Die Behandlung des Funktionsbegriffs in der höheren Schule. *L'enseignement mathématique, 2^e Série, 8* (1), 62–92.
17. Steiner, H.-G. (1963). Explizite Verwendung der reellen Zahlen in der Axiomatisierung der Geometrie. *Der Mathematikunterricht 9* (4), 66–87.
18. Steiner, H.-G. (1964a). Frege und die Grundlagen der Geometrie I. *Mathematisch-Physikalische Semesterberichte, 10* (1), 35–47.
19. Steiner, H.-G. (1964b). Moderne begriffliche Methoden bei der Behandlung der komplexen Zahlen. *Der Mathematikunterricht, 10* (2), 5–35.
20. Steiner, H.-G. (1964c). Elementare Beweise zum Fundamentalsatz der Algebra. *Der Mathematikunterricht, 10* (2), 60–93.
21. Steiner, H.-G. (1964d). Kardinal- und Ordinalzahlen. In H. Behnke, R. Remmert, H.-G. Steiner & H. Tietz (Eds.) *Fischer-Lexikon Mathematik I*, *Bd. 29* (pp. 166–196). Frankfurt: Fischer Taschenbuch Verlag.
22. Steiner, H.-G. (1964e). Logik und Methodologie. In H. Behnke, R. Remmert, H.-G. Steiner & H. Tietz (Eds.) *Fischer-Lexikon Mathematik I*, *Bd. 29* (pp. 196–227). Frankfurt: Fischer Taschenbuch Verlag.
23. Steiner, H.-G. (1964f). Mathematische Grundlagenforschung. In H. Behnke, R. Remmert, H.-G. Steiner & H. Tietz (Eds.) *Fischer-Lexikon Mathematik I*, *Bd. 29* (pp. 227–246). Frankfurt: Fischer Taschenbuch Verlag.
24. Steiner, H.-G. (1964g). Mengen, Abbildungen, Strukturen. In H. Behnke, R. Remmert, H.-G. Steiner & H. Tietz (Eds.) *Fischer-Lexikon Mathematik I*, *Bd. 29* (pp. 246–292). Frankfurt: Fischer Taschenbuch Verlag.
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26. Steiner, H.-G. (1964i). Relations and functions. Mathematics today. *The Mathematics Teacher, 57* (3), 251–257.
27. Steiner, H.-G. (1964/1965a). Menge und Struktur als Leitlinie für den mathematischen Unterricht I. *Der mathematisch-naturwissenschaftliche Unterricht, 17* (5), 199–205.
28. Steiner, H.-G. (1964/1965b). Menge und Struktur als Leitlinie für den mathematischen Unterricht II. *Der mathematisch-naturwissenschaftliche Unterricht, 17* (6), 259–266.
29. Steiner, H.-G. (1965a). Frege und die Grundlagen der Geometrie II. *Mathematisch-Physikalische Semesterberichte, 10* (2), 175–186.
30. Steiner, H.-G. (1965b). Wie steht es mit der Modernisierung unseres Mathematikunterrichts? *Mathematisch-Physikalische Semesterberichte, 11* (2), 186–200.
31. Steiner, H.-G. (1965c). Menge, Struktur, Abbildung als Leitbegriffe für den modernen mathematischen Unterricht. *Der Mathematikunterricht, 11* (1), 5–19.
32. Steiner, H.-G. (1965d). Zur Didaktik der elementaren Gruppentheorie I. *Der Mathematikunterricht, 11* (2), 20–39.
33. Steiner, H.-G. (1965e). Kalküle und Rechenautomaten im Unterricht. *Der Mathematikunterricht, 11* (2), 100–109.
34. Steiner, H.-G. (1965f). Mathematische Grundlagenstandpunkte und Reform des Mathematikunterrichts. *Mathematisch-Physikalische Semesterberichte, 12* (1), 1–22.
35. Steiner, H.-G. (1965g). Quadratische Gleichungen und Quadratwurzelfunktionen in Körpern. *Mathematisch-Physikalische Semesterberichte, 12* (2), 211–229.
36. Steiner, H.-G. (1966a). Vektorraum, affine Geometrie, Abbildungen. *Der Mathematikunterricht, 12* (1), 16–31.
37. Steiner, H.-G. (1966b). Komplexe Zahlen, Quaternionen, Vektorrechnung. *Der Mathematikunterricht, 12* (1), 75–99.

38. Steiner, H.-G. (1966c). Anwendung der komplexen Zahlen im Physikunterricht. *Der Mathematikunterricht, 12* (1), 45–54.
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Edited Book Series

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Appendix 2

Organization and co-organization of congresses, conferences, workshops by Hans-Georg Steiner (co-organizers are only partly known)

1. *Münsteraner Tagungen zur Pflege des Zusammenhangs von Schule und Universität*—Münster Conferences for the Furtherance of the Connection between School and University. University of Münster, 1955–1967
2. *Studientagungen für belgische und luxemburgische Mathematiklehrer*—Study Conference for Mathematics Teachers in Belgium and Luxembourg. University of Münster, 1963, 1964, 1966, 1967
3. *Die Neugestaltung des Mathematikunterrichts an den höheren Schulen*—The Restructuring of Mathematics teaching at College-Bound High Schools. ICMI/IMUK-Regional Conference, Vienna, 1966
4. *Arbeitstagung des Zentrums für Didaktik der Mathematik an der Universität Karlsruhe zu Fragen der Grundlagenforschung und mathematischen Logik im Unterricht*—Workshop on Foundations of Mathematics and Mathematical Logic in Mathematics Instruction Conducted by the Centre of Didactics of Mathematics at the University of Karlsruhe. Oberwolfach, June 30–July 2, 1968
5. *Arbeitstagung zum Stand der Didaktik der Algebra und zur Vorbereitung der Entwicklung eines Lese- und Arbeitsbuchs zur modernen elementaren Algebra für 12- bis 19-Jährige*—Workshop on Didactics of Algebra and the Preparation of a Text Book for Modern Elementary Algebra Aimed at 12- to 19-Year-Old Students. Kassel, April 8–13, 1969
6. 2nd CSMP international conference: The Teaching of Geometry at the Pre-College Level. Carbondale, Illinois, March 19–28, 1970
7. *Bundestagung für Didaktik der Mathematik*—National Conference on Didactics of Mathematics. Bayreuth, April 14–16, 1971
8. ICMI–IDM Regional Conference on the Teaching of Geometry. Bielefeld, September 16–20, 1974
9. *Kritische Auseinandersetzung mit dem ''Normenbuch'' Mathematik—Critical Analysis of the Examination Standards for Upper Secondary Final Examinations. Bielefeld, October 11–12, 1975*
10. *Zur Situation der Unterrichtsgebiete Analysis und Lineare Algebra/Analytische Geometrie*—On the Situation of Teaching Analysis and Linear Algebra/Analytical Geometry. December 1974, March 1975, October 1975, December 1975, February 1976
11. 3rd International Congress on Mathematical Education (ICME-3). Karlsruhe, August 16 –21, 1976 (as chair of the international program committee)[2]
12. *Zur Situation der Didaktik der Mathematik im Studium der Mathematiklehrer für die Sekundarstufe II*—On the Situation of Didactics of Mathematics in Secondary Mathematics Teacher Preservice Education. Bielefeld, October 8–14, 1976
13. *Tendenzen und Probleme des Mathematikunterrichts in der Sekundarstufe II*—Trends and Problems in Mathematics Teaching at Upper Secondary Level. Bielefeld, December 13–15, 1976
14. *Informatik im Unterricht der Sekundarstufe II: Grundfragen, Probleme und Tendenzen mit Bezug auf allgemeinbildende und berufsqualifizierende Ausbildungsgänge*—Information Technology in Upper Secondary Classrooms: Basic Questions, Problems and Trends with Respect to General and Vocational Education. Bielefeld, September 12–14, 1977
15. *Zum Verhältnis von Mathematik und Philosophie im Unterricht der Sekundarstufe II/Kollegschule*—On the Relationship Between Mathematics and Philosophy in Upper Secondary Education. Bielefeld, December 6–7, 1977, April 26–28, 1978
16. The Education of Mathematics Teachers. What Knowledge, Experience, and Understanding of Mathematics should a Mathematics Teacher Have? ICMI-UNESCO-IDM Symposium at the International Mathematician Congress in Helsinki, August 15–23, 1978

[2] Hans-Georg Steiner was also a member of the International Program Committee of ICME 1, 2, 4 and 5.

17. Co-operation between Science Teachers and Mathematics Teachers. UNESCO-ICSU-ICPE-ICMI-IDM-Conference. Bielefeld, September 17–23, 1978
18. Comparative Studies of Mathematics Curricula. Change and stability 1960–1980. IDM-UNESCO-SIMS Conference. Osnabrück, January 7–11, 1980
19. *Internationale Tagung zur Methodologie der 2. Internationalen Mathematikstudie*—International Conference on the Methodology of the 2nd International Mathematics Study. Bielefeld, January 13–18, 1980
20. *Fragen der Differenzierung im Mathematikunterricht der gymnasialen Oberstufe*—Questions Concerning the Differentiation in Mathematics Teaching at the Upper Secondary Level. Osnabrück, June 1–5, 1982
21. What Should be the Goals and Contents of General Mathematics Education? ICMI Symposium at the International Mathematicians Congress in Warsaw, August 16–24, 1983
22. *Arbeitstagungen zur Entwicklung mathematischer Fähigkeiten*—Workshops on the Development of Mathematical Competencies. Bielefeld, November 24–25, 1983, April 2–3, 1984
23. *Wissenschafts- und Bildungsgeschichte im Zusammenhang mit mathematikdidaktischer Forschung*—History of Science and Education in the Context of Mathematics Education Research. GDM-IDM Conference. Osnabrück, May 7–12, 1984
24. Topic Area at ICME-5 and following international conference on ''Theory of Mathematics Education'' (TME-1 Conference). Adelaide, Australia, August 24–30, 1984
25. *Grundfragen der Entwicklung mathematischer Fähigkeiten*—Basic Questions with Respect to the Development of Mathematical Competencies. Osnabrück, January 7–13, 1985
26. International Conference on Foundations and Methodology of the Discipline Mathematics Education (Didactics of Mathematics) (TME-2 Conference). Bielefeld, July 15–19, 1985
27. *Zweite GDM-IDM-Arbeitstagung über Wissenschafts- und Bildungsgeschichte im Zusammenhang mit mathematikdidaktischer Forschung*—Second GDM-IDM Workshop on the History of Science and Education in the Context of Mathematics Education Research. Osnabrück, April 7–11, 1986
28. *Deutsch-französisches bilaterales Symposium zur Förderung des wissenschaftlichen Erfahrungsaustauschs und der Zusammenarbeit im Bereich der mathematikdidaktischen Forschung*—Bilateral German-French Symposium on the Enhancement of Scientific Exchange and Cooperation in Mathematics Education Research, Marseille-Luminy. November 16–21, 1986 (together with Colette Laborde)
29. International Seminar on Comparative Studies of Mathematics Curricula. Centro Europeo dell'Educazione. Frascati (Rome), May 18–23, 1987
30. International Conference on Investigating and Bridging the Teaching-Learning Gap. (TME-3 Conference). Antwerp, July 11–15, 1988
31. Topic area ''Theory of Mathematics Education'' on the 6th International Congress on Mathematical Education (ICME-6). Budapest, July 23–27, 1988
32. International Symposium on Research and Development in Mathematics Education. Bratislava, August 3–7, 1988
33. First Bilateral Italian-German Symposium on Didactics of Mathematics. Pavia, October 4–9, 1988 (together with Luciana Bazzini)
34. Bilateral German-Israeli symposium ''Logo in the Classroom: From Ideas to Implementation and Practice. Bielefeld, November 1988
35. Fourth International Conference on Theory of Mathematics Education (TME-4 Conference). Oaxtepec, Mexico, July 3–7, 1990
36. Second Bratislava International Symposium on Mathematics Education (BISME-2). Bratislava, August 22–25, 1990
37. *Symposium zur Förderung der wissenschaftlichen Zusammenarbeit in der Mathematikdidaktik in Deutschland*—Symposium on the Enhancement of the Scientific Cooperation in Didactics of Mathematics in Germany. Osnabrück, October 21–28, 1990
38. *Arbeitstagung über „Offene Systeme und mathematisch-naturwissenschaftliche Bildung''*—Workshop on Open Systems and Mathematics and Science Education. Osnabrück, March 11–15, 1991
39. Fifth International Conference on the Theory of Mathematics Education (TME–5). Paderno del Grappa, Italy, June 20–27, 1991
40. Second Bilateral Italian-German Symposium on Didactics of Mathematics. Osnabrück, April 21–26, 1992 (together with Luciana Bazzini)
41. *Arbeitstagung „Neue problem- und praxisbezogene Forschungsansätze''*—Workshop on New Problem and Practice related Research Approaches. Osnabrück, August 30–September 4, 1993 (together with Hans-Joachim Vollrath)

42. *Komparative Forschung zur Entwicklung und Ausprägung des Mathematikunterrichts und der Mathematikdidaktik als Wissenschaftsdisziplin in der BRD und der DDR von 1945 bis 1990 und ihre Bedeutung für die gegenwärtigen und künftigen Entwicklungen in Deutschland*—Comparative Research on the Development and Status-quo of Mathematics Teaching and the Didactics of Mathematics as a Scientific Discipline in the Federal Republic of Germany and the German Democratic Republic from 1945 to 1990 and their Implications for Present and Future Developments in Germany. Osnabrück 1996 and Magdeburg 1996 (together with Werner Walsch, Halle)

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