

Social groups in mathematics education research. An investigation into mathematics education-related research articles published from 1971 to 2000

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This paper provides data and comments on mathematics education research articles published in educational journals from various categories the latest thirty years (1971-2000). The Educational Resources Information Center (ERIC) Database was utilised as a data source and articles reporting or commenting on research relating to social groups defined along lines of social class or socio-economic status, gender or sex, ethnicity or race, demographic minority and economic or educational disadvantage were identified. Topics related to teaching and learning of mathematics most frequently appearing as focal points of mathematics education research were also identified. Based on the results of a simple quantitative analysis of the relevant data series, it is argued that in mathematics education-related research the issues of social groups considered are given inconsiderable attention, however relatively equivalent to the attention given in educational research as a whole throughout the time period considered. On the other hand, the issues of mathematics achievement and learning were identified as the primary topics of interest over the thirty years considered. Such a prevailing situation in the field of research in mathematics education unavoidably results at a loss of probing the particular interrelationships of mathematics education to contextual, social, political and cultural factors.

Rationale

Mathematics education as a research domain and consequently as a field of knowledge has been subject to many critiques which, in my view, may be classified into two very broad classes.

A first class comprises critiques, which - in line to a more general attack against educational research that has been developed during the latest two decades - call into question the epistemological status, the subject of study, and the necessity or the value of research in mathematics education. These critiques may be considered to have a rather «global» character and they approach research in mathematics education from a relationally «external» to the field viewpoint, while, employing an «internalistic» perspective in relation to the academic world. In the first instance, these critiques conceive the research in mathematics education as an intellectual practice.

In a second class of critiques, are included approaches, which adopt particular perspectives ascribing to the «mainstream» research in mathematics education a deficit in one area or another. Accordingly, these critiques may be considered to have a rather «local» character and they approach the research in mathematics education from a stance, which is «internal» to the field, while employing an «externalistic» perspective in relation to the academic world. In

the last instance, these critiques conceive the research in mathematics education as a social practice.

Both types of critiques are more or less exemplified either in the contents of the two volumes of «Mathematics education as a research domain: a search for identity» (Sierpinska and Kilpatrick, 1998) or more vividly in their published reviews (e.g., Steen, 1999, King and McLeod, 1999).

A particular trend, which falls within that later class of critiques, asserts that «mainstream» mathematics education-related research is ignoring critical social, political or economic aspects of its object of inquiry. Tate (1997), for instance, argues that mathematics education research tends to be narrowly focused, restricted to the disciplines of mathematics and psychology. Hudson (2001) in accord stresses that this phenomenon can be clearly seen in the fact that the International Group for the Psychology of Mathematics Education (PME) has become the major international forum for mathematics education research. Reyes and Stanic (1988) and Secada (1992) claimed that mathematics education researchers have virtually ignored issues of poverty and social class. Campbell (1989) asserted that mathematics education researchers rarely consider intersections of social group areas, such as are, for instance, ethnicity and gender. Lubienski and Bowen (2000) based on the evidence resulting from a survey of mathematics education research articles published between 1982 and 1998 in educational research journals concluded that the majority of mainstream mathematics education research focuses on student cognition and outcomes, with less attention to social or cultural issues.

These and similar charges against research in mathematics education, however, either grounded on one's own subjective impressions or on some kind of objective evidence yielded by surveys of the mathematics education research literature are, in my view, characterised by a one-sidedness. And above all, they do not offer any kind of explanation for the facts they spot and denounce so as the relevant choices of the mathematics education research community to appear in some respects as being scientifically arbitrary and politically deliberated. In this account, the present paper has not to be conceived as a justification of the «mainstream» mathematics education research for any deficits in social issues but must be read as an attempt to provide a broad look at the issue from a relational standpoint. Such a standpoint means that mathematics education research, at any particular moment, must be considered as related to its own past and future characteristics, as well as to the past and future characteristics of its context.

Thus, history (each aspect is related to its own past and future characteristics), context (for this aspect, in this context, this is the influence most worth noting), and dialectic (things may be viewed as moments in their development in, with and through other things) are essential components of a relational standpoint and have been subsumed in the study reported in this paper.

In this study 13,999 articles reporting or commenting on mathematics education-related research, published between 1971 and 2000, were counted and categorised. And those that contained a reference to any social group defined along lines of social class or socio-economic status, gender or sex, ethnicity or race, demographic minority and economic or educational disadvantage were identified. In addition, main topics related to teaching and learning of mathematics that appear most frequently as focal points of mathematics education-related research were identified. Mathematics education-related research was defined broadly, encompassing any research venture related in any of its facets to any issue concerning – directly or indirectly - mathematics education.

The data series brought out were analysed in direct comparison to the corresponding data concerning articles reporting or commenting on research in any education-related field. By such an analysis, which incorporates a strong comparative dimension, it was aimed at sketching out a broad and interpretable picture of the attention given to the social groups and topics under consideration in the "mainstream" mathematics education research.

The empirical investigation: Data collection and analysis

The method of data collection employed for the present study is similar in many respects to that of Lubienski and Bowen (2000). However, a different set of data has been collected and analysed, more social group categories have been considered and a primarily comparative reading of the collected data series has been applied, so as the outlined reality of mathematics education research to be interpretable, even from a particular point of view.

Data were drawn from the Educational Resources Information Center (ERIC) Database, accessible through the Internet, which contains more than one million abstracts of journal articles and documents on education research and practice published between January 1966 and mid 2001. ERIC Database is the world's largest source of education information and for over thirty years has been a widely used and well-known research tool (Hertzberg and Rudner, 1999).

This study focuses on articles published from 1971 to 2000 in journals and other periodical-type publications that contained at least some mathematics education-related research, presuming that these kinds of publications reflect more closely than documents published outside of the journal environment the interests and values of "mainstream" research communities. For the five years from 1966 to 1970 the ERIC Database contains a total of 42 articles published in periodical-type publications and just one relates to mathematics education, so this time period has been left out of the study reported in this paper.

The terms «mathematics» and «mathematical» as main descriptors, i.e. subject terms used by the ERIC system to characterise the substantive content of each archived document (Houston, 1995), and ERIC publication-type codes, i.e.

categories indicating the form or organisation of the document, were used to screen for mathematics education-related research articles.

A total of 13,999 articles remained to become the focus of analysis defined broadly as comprising the following six document-type categories: General reports; descriptive reports; evaluative or feasibility reports; research or technical reports; information analysis (state-of-the-art papers, research summaries, etc.); and viewpoints (opinion or position papers, essays, etc.) concerning research in mathematics education.

Analysis of the 13,999 articles involved counting electronically the number of articles that contained any ERIC descriptor pertaining to social groups defined along lines of social class or socio-economic status, gender or sex, ethnicity or race, demographic minority and economic or educational disadvantage. Secada (1992) considers the distinctions between social class and socio-economic status as pertaining to a distinction between larger, societal structures or groups and particular, individual persons. This distinction, and a similar one between gender and sex, as well as between ethnicity and race, have been adopted and used in this study.

Each social group category was defined in broad terms, using all relevant ERIC descriptors in an effort to include all research articles relating to the group.

Beyond and in contrast to social group categories, general topics related to teaching and learning of mathematics most frequently appearing as focal points of mathematics education research articles were identified using relevant keywords and descriptors.

The results of this simple quantitative analysis indicate the numbers of articles assigned a descriptor pertaining to various social groups and educational topics considered. Thus the validity of these results relies on the accuracy of both the ERIC system descriptors and our identifications or categorisations of those descriptors. It is important to note here that these categories may not be disjoint - for example, an article pertaining to a specific ethnic group may overlap with an article on educational disadvantage.

On the other hand, a simple count of the number of articles relating to an issue does not reveal the extent, quality or type of emphasis given to that issue. Therefore, it is not assumed that each social group or educational topic necessarily receive the same degree or type of emphasis. Despite these limitations, the breadth of the present study offers concrete evidence regarding the amount of attention given to various social groups and topics in "mainstream" mathematics education research.

The empirical investigation: Main findings

As already mentioned social class or socio-economic status, gender or sex, ethnicity or race, demographic minority and economic or educational disadvantage were the defining categories of the social groups examined in this

study. Each category was broadly defined, encompassing all relevant ERIC keywords and descriptors in an effort to include all journal articles relating to the relevant social group. The following table 1 shows the number of education-related and mathematics education-related research articles pertaining to each social group by years of publication grouped in decades.

The 13,999 mathematics education-related research articles correspond to 3.4% of the total number of education-related research articles published from 1971 to 2000. This percentage may be appreciated as an index of the relative volume of mathematics education research in comparison to the overall educational research published over the thirty years considered in this study.

A close examination of the data shown in table 1 reveals, that the attention given in mathematics education-related research to the social group categories considered may be characterised - at least on a simple quantitative basis - as absolutely low, however, relatively equivalent to the attention given in educational research regarded as a whole, throughout the time period considered.

With the exception of gender or sex issues, which was found to receive more attention by mathematics education-related research than by other educational research (6.2% in mathematics education in contrast to 4.8 % in all education research ERIC items). Relative to the total of 1,277 research articles pertaining to at least one of the social group categories considered a percentage of 67.5% was found to be related to gender or sex issues, in contrast to 50% of 39,449 ERIC items of the same pool.

	1971 – 1980		1981 – 1990		1991 – 2000		Total 1971 – 2000	
	All ERIC	Math	All ERIC	Math	All ERIC	Math	All ERIC	Math
Research Articles	37940 100%	857 100%	179581 100%	6177 100%	192045 100%	6965 100%	409566 100%	13999 100%
Social Class or SES	282 0.7%	1 0.1%	1283 0.7%	41 0.7%	1511 0.8%	15 0.2%	3076 0.8%	57 0.4%
Ethnicity or Race	437 1.2	3 0.4	1747 1.0	23 0.4	3347 1.7	63 0.9	5531 1.3	89 0.6
Gender or Sex	2015 5.3	50 5.8	8700 4.8	401 6.5	9010 4.7	411 5.9	19725 4.8	862 6.2
Minority groups	419 1.1	6 0.7	2591 1.4	85 1.4	4180 2.2	106 1.5	7190 1.8	197 1.4
Disadvantaged groups	423 1.1	6 0.7	1449 0.8	31 0.5	2068 1.1	35 0.5	3940 1.0	72 0.5
At least one of the social group categories	3576 9.4	66 7.7	15770 8.8	581 9.4	20116 10.5	630 9.0	39462 9.6	1277 9.1

Note. Percentages in this table are column percentages.

Table 1: Number and percentage of education and mathematics education research articles relating to each social group by years of publication in decades

Overall, issues related to social class or socio-economic status were found to have received the least attention among both the mathematics education and the entire pool of research articles pertaining to at least one of the social group categories considered in this study (0.4% and 4.5% respectively). There follow, with somewhat higher attention received, issues related to economically or educationally disadvantaged groups (0.5% and 5.6% respectively). However, a comparable picture for these two social group categories emerges when considering all education research ERIC items.

Trends on the relevant issues over the thirty years considered in this study, which characterise educational research in general, irrespective of its subject matter, may also be traced in mathematics education-related research.

As mentioned earlier the distinctions between social class and socio-economic status, gender and sex as well as between ethnicity and race are considered to be pertaining to a distinction between larger, societal structures or groups and particular, individual persons.

Although not included in the table, mathematics education research articles relating to social class category were found to be 23% less than the articles relating to socio-economic status (or 22 of the 57 articles) in contrast to a greater difference of 39% found between the ERIC items of the same pool (or 931 of the 3076 articles). Research articles relating to ethnicity, either to general conception or to specific ethnic groups, were found, in comparison to those relating to race category, to be the 95% of the total number of items both in mathematics education and all ERIC items of this pool. On the other hand, none of the 862 articles of mathematics education research and only 188 of the 3076 (or 1%) ERIC articles of the same pool were found to be referring to gender in contrast to sex category.

A differentiation of the articles published in mathematics education or in non-mathematics education journals and other periodical type publications yielded the following findings in brief.

The non-mathematics education journals contained more than 80% of the identified articles relating to at least one of the social group categories considered in this study (1032 out of the 1277 articles).

In mathematics education journals - including journals of computers or computing in mathematics education - published between 1971 and 2000 only 5 (or 9%) of the 57 articles related to social class or socio-economic status and 6 (or 7%) of the 89 articles related to ethnicity or race. Articles relating to minority groups and to economically or educationally disadvantaged groups, also, shared very low percentages in mathematics education journals (16% or 31 of the 197 and 12.5% or 9 of the 72 published articles). In a slightly higher percentage they appeared in mathematics education journals articles relating to

gender or sex (23% or 194 of the 862 items). In short, issues of gender or sex received much more attention in mathematics education journals than those relating to any other of the four social group categories considered in this study.

An investigation of more general topics relating to the teaching and learning of mathematics, summarised in table 2, showed that issues concerning mathematics achievement as well as issues concerning mathematics learning were equally the two most popular of the categories considered in mathematics education research articles published from 1971 to 2000. In contrast, educational achievement was found to have received the least attention among the entire pool of ERIC items (4.7%).

On the other hand, issues relating to mathematics cognition and mathematics curriculum were found to have received the least attention with an average percentage of 11.6% and 14%, respectively, of the articles considered. These two topics were also found to have relatively low popularity among the entire pool of ERIC research articles.

	1971 – 1980		1981 – 1990		1991 – 2000		Total 1971 – 2000	
	All ERIC	Math	All ERIC	Math	All ERIC	Math	All ERIC	Math
Research Articles	37940 100%	857 100%	179581 100%	6177 100%	192045 100%	6965 100%	409566 100%	13999 100%
Achievement	1818 4.8	135 15.8	8422 4.7	1123 18.2	9142 4.8	1214 17.4	19382 4.7	2472 17.7
Learning	3691 9.7	138 16.1	17388 9.7	915 14.8	24954 13.0	1412 20.3	46033 11.2	2465 17.6
Teaching	3068 8.1	111 13.0	15856 8.8	915 14.8	17681 9.2	1197 17.2	36605 8.9	2223 15.9
Teachers	5163 13.6	107 12.5	25881 14.4	792 12.8	31986 16.7	1244 17.9	63030 15.4	2143 15.3
Curriculum	2581 6.8	136 15.9	13319 7.4	962 15.6	14340 7.5	862 12.4	30240 7.4	1960 14.0
Cognition	1943 5.1	73 8.5	10702 6.0	694 11.2	9819 5.1	852 12.2	22464 5.5	1619 11.6
At least one of the above topics	18264 48.1	700 81.7	91568 51.0	5401 87.4	107922 56.2	6781 97.4	217754 53.2	12882 92.0

Note. Percentages in this table are column percentages.

Table 2: Number and percentage of mathematics education research articles relating to teaching and learning topics by years of publication in decades

Issues relating to teacher characteristics or actions were found to be equally popular among mathematics education and all ERIC research articles (15.3% and 15.4% respectively), but in a relative ordering they held the first place

among all ERIC items against the fourth among mathematics education research articles.

Overall, 92% of the mathematics education research articles analysed in this study (in contrast to 53% of all ERIC items) contained a descriptor pertaining to at least one of the six categories of mathematics teaching and learning considered.

By way of conclusion

The data reported in this paper outline a corpus of research articles directly or indirectly related to mathematics education, in which issues of social groups considered have received inconsiderable attention, in complete accordance to the relevant facts observed in educational research as a whole over the latest thirty years.

Gender or sex issues seem to be an exception, since they were found to have received relatively more attention by mathematics education-related research than by total educational research throughout the time period considered. This finding which indicates that gender or sex issues have gained significant attention in mathematics education research has to be, however, accompanied by the following remark. The type of analysis employed in the present study could not reveal the kind of attention given to gender issues in mathematics education-related research and above all, it could not reveal whether these issues were, in one way or another, associated with larger, societal structures and groups or not.

These findings, in conjunction with the evidence that achievement and learning were the two most popular topics in mathematics education-related research, allows the assertion that the outcomes and processes of mathematics education were conceived and investigated in individual rather than social terms. In such a situation, psychological and not sociological perspectives unavoidably prevail. This, without a doubt, offers substantial gains in mathematics education theory and practice, but, at the same time, has side-lined critical social, political and economic considerations. Furthermore, adopting and developing an individualised approach, mathematics education research has lost any functional sense of social structures and groups as well as any practical conception of the class, ethnic, gender and any other social relations that form the individual persons.

Individualisation and psychologisation may be considered as the primary factors, which have shaped the current situation in mathematics education-related research for the issues considered in this study.

A third, and possibly equally important factor, may be considered to be the influence of absolutist philosophies of mathematics in their various forms which regard mathematical knowledge as pure isolated knowledge, somehow above and beyond the social sphere, being for this reason value-free and culture-free.

Finally, the contribution of another set of factors related to political issues involving funding of research projects, mainstream journals' publication policies and processes, incongruities between the researchers' ideologies and the predominant culture of academia should not be underrated. Secada (1995) claims, and in my experience quite rightly, that mathematics education researchers who raise serious social equity concerns tend to be marginalised and held to higher standards of proof than other researchers.

It is clear from the evidence offered by this study and the induced considerations on the subject matter, that «mainstream» mathematics education-related research ignores to a great extent important social group categories, such as social class, gender, ethnicity, race, demographic minorities as well as the economically or educationally disadvantaged. These and any other conceptual categories concerning social structures are, of course, generalisations, and none can assume that their inclusion in a mathematics education-related ventures will cast dazzling light on the particular, and indisputably complex, interrelationships of various aspects of teaching and learning mathematics to their contextual, social, political or cultural factors. Their exclusion, however, eliminates any possibility of investigation.

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