

# **Surveying the Field of Mathematics Education Research**

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## **Introduction**

In our study (Lerman, Xu & Tsatsaroni, 2003a, b, c; Tsatsaroni, Lerman & Xu, in press) we have constructed an analytical tool to examine the discursive shifts and changes in the textual productions of the mathematics education research community over the last 12 years. Subsequently, we have tried to develop a language through which to understand better this community's research activity as discursive practice wherein researchers' identities are continually re-constituted. In this paper therefore we will take a step back from the specific focus of this meeting and attempt to indicate how we set its work in the context of the wider concerns that motivated our research project.

## **Background to our project**

Changing patterns of knowledge production, accumulation and use is today, more than ever, a major issue that concerns not only those who produce knowledge, but also different kinds of users, among which are policy makers in their double capacity: to use the knowledge and to influence its production. In our project we have sought to raise questions concerning the standing of the field of mathematics education research in the wider field of intellectual knowledge production, the position of the field's actors in their own field and their positioning vis-à-vis the official and public discourses and everyday school practice. The project was motivated by a concern to examine the state of a particular research field, in this case mathematics education, the identities of researchers in the field, and how the field reproduces itself over time. We wanted this project to be based on a systematic and rigorous study of a broader database. We were also concerned that the study should draw on the most recent work in the sociology of education, providing a theoretical basis for the study itself. In this way the study could be reflexive. One of our inspirations has been the knowledge that school mathematics is a gatekeeper in compulsory schooling and beyond, yet the field of study that theorises and researches this subject constitutes a small field. Furthermore, the general field of educational studies, in which it is located, is

currently under threat, its sub-fields becoming detached and insulated from one another.

There have been a number of studies of mathematics education research that have addressed some aspects of the aims of our project. Kieran's (1995) retrospective look at mathematics education research on learning presented interviews with two leading researchers looking back over that period, followed by an analysis of articles published in *Journal for Research in Mathematics Education* (JRME) in its first 25 years building on the remarks of the researchers in the first section. She argued that there has been a shift towards integrating learning with understanding and studying them together, as well as an increasing orientation towards interactionist studies drawing on Vygotskian ideas. Niss (2000) developed an account of the field "based on sample observations obtained from probing into research journals, *ICME (International Congress on Mathematical Education)* proceedings and other research publications from the last third of the 20<sup>th</sup> century" (pp 1-2, italics added). Niss gave examples from these publications in his review of issues and questions; objects and phenomena; research methods; results; and emerging problems and challenges. In the latter he presented his thoughts as being more speculative than on the other issues. Whilst Niss does not claim to have been systematic, the structure he provided enabled him to trace developments across the years from curriculum and how to teach, to classroom studies and then beyond to outside influences on the classroom. Chassapis (2002) searched the ERIC database for mathematics education-related publications between 1971 and 2000, a total of 13,999 articles altogether, for reference to social class, ethnicity, gender, minority or disadvantaged groups. His study expanded on an earlier study by Lubienski and Bowen (2000), which looked at the ERIC database for 1982-1998 and concluded that "in comparison with research on ethnicity, class, and disability, research on gender was more prevalent and integrated into mainstream US mathematics education research" (p. 626). Hanna & Sidoli (2002) looked back through the issues of the journal *Educational Studies in Mathematics* (ESM) on the occasion of the publication of the fiftieth volume. Following an account of the contributions of past editors the authors presented a statistical profile of articles by 4 categories: content area; educational issue; level of schooling; and research method. They also gave an account of the themes, editors and structure of the Special Issues.

The concerns of these studies vary from being mainly pedagogical to sociological and they also attempt to capture qualities to do with the research activity characteristic of the field. These studies contribute to sketching a rough picture of the field, pointing to some of its developments over time.

In our project we attempted to be systematic in our analysis, to develop a research tool for the analysis of a statistically sound representative selection of texts, and to generate a language of description capable of showing the effects of that which it describes. Whilst any selection of journals and other sources, and of language of publication frames and therefore limits the findings, we were able to choose a wider sample than the studies referred to here and to extend the range of aspects of research that were analysed. The development of the tool and the language of description, set against a background of sociological theory has enabled, we would argue, a justified set of conclusions regarding the state of the field that is open to critical examination by others.

### **Methodology**

In the context of this project journal articles and conference papers are seen as instances/representations of the research activity in the field under consideration. Our method of working to create this picture was to look first at specialised texts of the research field, namely a representative sample of the last 12 years of the papers in the *Proceedings of the International Group for the Psychology of Mathematics Education* (PME), and of two journals: ESM, published by Kluwer in Holland; and JRME published by National Council of Teachers of Mathematics in the USA. Whilst the choice of years of publications to analyse was to some extent arbitrary it was based on two factors: we wanted to bring the analysis up to the present day; and we are most interested in the years since the entry of more social theories into the field (see Lerman, 2000). Given the size of the task, even just analysing the two journals ESM and JRME and the Proceedings of PME over 12 years it was necessary to make a systematic selection. In relation to ESM we have chosen to examine every article from every second 'book' (using the term 'volume' or 'issue' risks confusion). We consider that, in terms of randomness, the articles published bear no relation to each other or to authors' names, except for the Special Issues. In these cases we conjecture that the only category affected would be the topic since methodologies, theories and all the other elements of our analysis will vary across these articles as much as in any

other book. We have also examined the Special Issues separately for topic. For JRME we have examined every article from every other book and for PME the articles we chose were every tenth research report from each of the proceedings. Were there time we would have liked to look back across the whole 50 volumes of ESM, the 33 volumes of JRME and the 27 years of PME and we expect that the changes would be quite substantial. We certainly expect less changes over a 12 year period but our project's focus is the field of mathematics education research more as shaped now, and on its future possibilities and prospects.

We developed a tool of recording and analysing the specialised texts of the research community, not by using any existing methods of textual analysis but by drawing broadly on Basil Bernstein's work. Indeed our thinking in framing the project and its subsequent development have been shaped in particular by his latest work on intellectual fields and knowledge structures. For example, we view new theories as, in general, positioned alongside other theories and not replacing them, as one might expect to happen in the development of theories in science. Bernstein (e.g. 2000) calls this a horizontal knowledge structure.

The tool changed as we interrogated more articles and found our categories inadequate or requiring modification. A key factor was the development of justifications for judgements, what Bernstein (2000) calls recognition and realisation rules, for what makes us place an aspect of an article in one category or another in an explicit manner. We were concerned that this project should be an empirical, descriptive study, and at the same time to generate a language that would help to make sense of the data.

Certain structural features, drawn from a variety of places, were used to construct the tool (see Appendix 1). To start with, we have made a distinction between an orientation towards the theoretical or towards the empirical, according to which domain has been privileged. In recording the information, then, first we asked whether the authors drew on any theories or not. If they did, then we would look at what theory they drew on and whether they drew on theory explicitly or implicitly. After this, we would make a distinction between the orientation of the paper, towards the theoretical or towards the empirical. Articles in the first category may move to the empirical to illustrate the theory, but in this category the intention of the article is to present and perhaps to develop theory. Similarly, articles that are orientated towards

the empirical may well draw on theory, but their orientation is towards describing and perhaps informing school practice, policy, or other site of practice. We then analyse how theory is used, whether it is supported or modified, and whether theories from other fields are used. If the orientation of a research paper was towards the empirical we looked at what was the focus of the empirical, whether school practice, researchers' practice, etc., and what methodology, data collection and analysis have been used. We also looked at the relationship between theory and the empirical, in the sense of whether the theory informs the empirical, is informed by the empirical, or there is a dialectic between them.

The next two categories of the tool, 'researchers' aims' and 'ideological affiliations', are used with the intention, first, to capture the purpose of the research and if this is in some sense pedagogic, the mathematical topic and the sector of education the article is concerned with; second, to identify the addressees of the article, such as other researchers, researchers and teachers, etc; and third, to explore the question of whether the author(s) overtly adopt a particular ideological affiliation, such as feminist, post-modern, or other.

The final category examines the pedagogical model projected/promoted in the paper of the authors, where one has been identified. Here we have been influenced by Bernstein's classification of performance and competence models, and their subdivisions: within the former what Bernstein has identified as old and new performance models, and within the latter what he has named liberal-progressive, cultural-populist and political-emancipatory modes, each with its distinct ideology (Bernstein, 1996). The justifications used for distinguishing between different pedagogical models and modes are: (a) whether the authors look to competence of pupils, i.e. what the students know, based on what they say and write, or performance, i.e., directly on how they perform; (b) whether the focus of the authors was on groups or individuals, and (c) whether or not there was a concern for cognitive, cultural or political empowerment. Additional sub-categories have been derived from Morgan, *et al* (2002); and as seen in the item 5 of the analytical tool (Appendix 1), the category "pedagogical models" includes three sub-questions: The first is whether the orientation is towards a knowledge mode or towards pupils, the knower mode (see also Lerman & Tsatsaroni, 1998 and Maton, 2000). The second sub-question concerns the strategy (cf. Dowling, 1998, cf Brown, 1999), whether the authors look towards

what is present or absent in students' texts and whether they make comments which present mathematics as a specialised or as a localised activity. For example, where everyday examples were used, we examined whether these were harnessed into the esoteric language of school mathematics or remained in everyday language and meanings. The third sub-question concerns the nature of the boundary between the everyday and specialised mathematics discourse and whether the boundary is presented as strong or weak.

The analytical tool has provided us with data on each text, which have been recorded in a database. This also includes the usual reference, a summary of the topic of the research and, where supplied, the authors' keywords.

We will now take as an example one article at random and indicate the rules by which we allocate classificatory criteria. We invite readers to follow and critique those rules. The article was published in volume 28 of *ESM* and the authors are Ma Tzu-Long Yang and Paul Cobb (1995). Looking first at theory, the authors are **explicit** about their use of Vygotskian theory (p. 4) and of finding inspiration in Bishop's work on enculturation (p. 3) in particular. It is a paper orientated to the **empirical** in that it looks to a study of Taiwanese and USA children to create theories for differences in competence in arithmetical thinking (p. 4). The empirical is privileged; explanations for differences in learning emerged by conjecturing influences from a reading of the data, not from within the theory. Its focus is on **school** practice and, further, looks at pupils' cognition. **Theory informs the empirical** as the researchers develop sociocultural explanations for the differences the two studies reveal (pp. 27-30). The authors address **teachers**, in providing implications for classroom practice (p. 31) but also **researchers** in their emphasis on what is revealed by their theoretical orientation (p. 29). The authors draw on Vygotskian theory, an intellectual resource beyond traditional psychology and mathematics. Below we will indicate that our classification of the theories authors have used takes mathematics and traditional psychology as the typical and records engagement with theories other than those. The authors do not seek to modify or critique the theory they have used. We categorise the location of their research as **using theory**. The article is not addressed to policy makers or official agencies but to the mathematics education community. Finally, giving a positive answer to the question of whether this article promotes a particular pedagogical model, we have identified its pedagogical orientation as being towards

individual pupils, aiming at their cognitive development, and supported by a liberal-progressive ideology. Furthermore, the pedagogical discourse constructed draws a strong boundary between mathematics and the everyday, mathematics is presented as a specialised discourse and its pedagogy is that of what Bernstein has called invisible pedagogy, whereby the focus of the teacher is on what is present in a pupil's text-answer, leaving implicit the criteria for its evaluation.

As part of our language of description we developed a two-dimensional framework drawing in part on Muller (2000) (Appendix 2). The *vertical* axis gives us information on the agents' *positioning* in their activity, with *looking inwards* and *looking outwards* as the two sides of the axis. 'Inwards' refers to either or both the wider intellectual field, or/and their own field, while 'outwards' refers to either or both the public sphere or/and the state/school field. The *horizontal* axis gives us information on the *form of the agents' engagement* with the activity. This again involves either a *critical* or a *functional* stance, as the two sides of the axis. 'Critical' presupposes an engagement with intellectual resources (of their own or others) with a view to *developing* their (and other) field(s) resources of research or an engagement in activity seen as *strengthening* the public sphere (including the schools). Functional refers to an engagement with their (or others') field(s) resources which is *using* the resources to carry out *describe* what is perceived as their task or an engagement which uses the resources to *prescribe* actions in the field perceived as the field of its application. Accordingly, four positions are derived that constitute the model: *Academic intellectual*, *career academic*, *public intellectual* and *(teacher) educator*. Needless to say we cannot expect to find in our data pure positions. They are not ideal types either, but they have been generated to assist in the description and explanation of the empirical.

## **Results**

The results of the analysis are indicated in the Appendices: Appendix 1 is the final version of our analytical tool; Appendix 2 is the framework we have developed as part of our internal language of description; and Appendix 3 contains a selection of tables in each of the categories of the analytical tool (for a complete set of results see Tsatsaroni *et al*, in press). We will summarise here some of the most interesting findings from this analysis as contained in the tables of Appendix 3. We will then make a few remarks in relation to the diagram in Appendix 2.

Some interesting changes have been depicted concerning the item '*theory type*'. The predominant theories throughout the period examined for all three types of text are traditional psychological and mathematics theories, but there is an expanding range of theories used from other fields. After a first listing of the theories used, table 1 (Appendix 3) was constructed out of the following categories: psycho-social studies, sociology/sociology of education/socio-cultural studies & historically orientated studies, linguistics/social linguistics & semiotics, philosophy/philosophy of mathematics, educational theory/educational research/neighbouring fields of mathematics education & curriculum studies. In the Table there is also space to record those cases where no theory has been used. To enhance readability, the data obtained from each type of text were grouped into two time periods (1990-1995 & 1996-2001), though detailed year by year tables are also available. The first interesting point to notice is that, as already said, the predominant fields from which researchers draw in all three journals are traditional psychological & mathematical theories, though the percentage in JRME, in the first period, is substantially lower, compared to the other two. Over the two period spans papers drawing on traditional psychology and mathematics have decreased in PME and ESM (from 73.1% to 60.5% for PME; and from 63.4% to 51.6% in ESM), but have increased in the case of JRME (from 54.8% to 57.9%). As seen in table 3, this finding must be linked to the substantially higher percentage of JRME papers which exhibit an 'empiricism', i.e., did not draw on any theory in the first period (24.2%, compared to 6.0% in PME, and 9.8 in ESM), while in the second period there is a substantial drop in the papers that are found not to use theories at all from 24.2% to 10.5%. There is a drop also in ESM papers, but not substantial and a slight increase in PME papers that do not draw on any theory; though the numbers of the papers considered is small to allow any hypotheses. The second point to notice is that a good number of papers in all three types of text draw on psycho-social theories, including re-emerging ones, and that this is on the increase in ESM & JRME over the two time periods (from 9.8% to 20.0% and from 6.5% to 13.2%, respectively), with a very slight decrease in PME texts (from 11.9% to 9.9%). The papers drawing on sociological and socio-cultural theories are also on the increase (from 3.0% to 9.9% in PME, from 3.7 to 11.6% in ESM, and from 1.6 to 7.9 in JRME) but they are all below 12%; and there is a noticeable increase, over the two time periods, in the use of linguistics, social linguistics and semiotics in all three types of text, though the number of papers drawing on these are still very small. Finally, it

is worth noticing that very few papers draw on the broader field of educational theory and research, and on neighbouring fields of science education and curriculum studies, and if anything percentages are falling.

Looking at the data from the point of view of *the methods* used in reports on empirical studies in our sample, we observe that, on average, there is a major emphasis in PME and ESM on qualitative types of inquiry (63.7% and 62.6% respectively), with 16.3% and 15.8% quantitative, and 20.0% and 21.6% mixed methods respectively. JRME places equal emphasis on quantitative (43.4%) and qualitative (41.0%), while 15.6% in the sample uses mixed methods (see Table 2, in Appendix 3). In order to discuss the pattern of change over time we have collapsed the data as before into two (6-year) time periods, a further justification being that the number of ESM articles with an emphasis on quantitative methods falls off dramatically in 1996. We should note here that we have looked at equal sized samples in each journal/conference proceedings each year and that we weight papers from proceedings at same level as the two journals and therefore we have produced unweighted totals. As shown in Table 2 (Appendix 3):

- There is a decrease over time (the two periods) in the number of articles that use quantitative methods in both journals, but an increase in PME.
- There is an increase in the number of articles using qualitative methods in the two journals but not in PME.
- The percentage of articles with quantitative and qualitative methods are the same in JRME, but qualitative methods are higher in both PME and ESM.

To account for this pattern of change we, first, contrast journal articles with the proceedings and on the basis of it we can argue that there appears to be a policy or regulative mechanism in place in the two journals that encourages researchers to move from quantitative to qualitative methods. Such a drive is not evident in PME. By comparing, secondly, the differences/similarities between the proceedings on the one hand, and each of the journals on the other, a policy of a balanced use of qualitative and quantitative methods can be hypothesised for PME and JRME but not for ESM. Thus given the initial emphasis on qualitative methods in PME the existence of such regulation explains the increase in PME of quantitative, and not of qualitative, research over the two periods. Similarly, given the initial emphasis of JRME on quantitative research, such policy explains the increase in qualitative research, and the

balance overall over the two time periods. Finally in comparing the similarities and differences between the two journals, the influence of context (USA versus Europe) must be considered. JRME, as already shown moves from an initial emphasis on quantitative to qualitative with achieving a more balanced use of methods. In contrast ESM's commitment to qualitative research appears to be stable over the two periods. Tradition and fashion in Europe could account for this preference and commitment to qualitative kinds of inquiry. One could also venture the interpretation that this commitment to qualitative research on the part of ESM (e.g. its editors) might also be evidence of the existence of pockets of resistance to external attempts to regulate the field, which are at present witnessed in educational and social research more generally. Thus a balanced use of methods might be but an imposed measure, a social control mechanism which appears as a plea for more realistic or pragmatic approaches to social inquiry. Or according to other social theorists, this is the era of re-emerging 'positivity' where there is a subtle critique and commentary still to be undertaken, yet on the whole one feels that many of the disputes and dualisms have run out of steam; that the very idea of coherent, boxed up and incommensurable 'paradigms' as a way of classifying and dealing with theoretical and methodological disputes in the social sciences no longer reflects the more fluid and pragmatic way in which standard issues are addressed today (cf MacLennan, 2000).

Following Kilpatrick (1992) we take psychology and mathematics as having a long history as intellectual fields at the heart of the discipline and comment on other intellectual resources as they have appeared in our sampling and recorded in detailed year by year tables. We listed the theoretical fields drawn upon by authors, and we based our judgements on authors' explicit references to them, some of whom were referring to a named authority. These fields or names represent theories used, not the frequency of their occurrence in papers. We grouped these together, using categories which are readily recognised among the members of this research community. In ESM, there is an increase in the number of fields during the period examined. It also appears that while psycho-social approaches are used steadily, quite a range of social/sociological as well as sociolinguistic theories are being used increasingly by authors, though the numbers remain small. In JRME psycho-social theories appear to be constant in the authors' preferences over the whole period but here, too, a broader range of intellectual fields, mainly theories from sociology, socio-cultural studies,

linguistics, social linguistics and semiotics, though in small numbers, have been used during the years examined. In PME proceedings, which traditionally is dominated by Psychology, as its name also states, there has been a substantial increase in the number of fields from 1994, although it is too early to say whether this trend will continue, as 1999 and 2000 showed a dropping off – though not in 2001. What is clear is that the range of intellectual resources today is somehow broader than the beginning of the 1990s.

With regard to the pedagogical model of researchers, from our analyses we conclude that the everyday school practice features in a normative way in mathematics education research and that the main practice promoted is one which is supported by a liberal-progressive ideology, aims at individual cognitive understanding, is orientated mainly to the pupil-knower and, consistent with these characteristics of the model, it indicates that the focus should be on what is present in the student's text and on mathematics as a distinct, specialised form of activity. However the feature of the strong boundary between mathematics and the everyday experiences of pupils shows some degree of inconsistency in the construction of this pedagogical model.

When we come to make some brief remarks from our findings regarding what we can call the *state of the field* drawing on the diagram in Appendix 2 we find an absence and also a dominance. The finding that 'mathematics education' seems to define its space of activity almost exclusively around the school suggests to us that there is no sign of a positioning in the field of research where the *public intellectual* would have a role to play, that there is no value in recognition. Our interpretation of the data is that the most dominant positioning is of the *researcher as teacher educator* (see Table 3 in Appendix 3). For example, the main addressees are in the category 'researchers and teachers' (72.3% in ESM, 65.9% in JRME and 75.7% in PME). Our case can be further supported if we look at our findings on the item 'pedagogical model'. Most papers explicitly construct a pedagogical model (85.3%, 89.1% and 83.8% in ESM, JRME and PME respectively; see Table 4 in Appendix 3). The model prescribed is that of the *individual learner-knower* – consistent with the interest in problem-solving as the focus of research – with almost all the features of liberal-progressive pedagogy being valued overall. Furthermore the finding that almost no political or cultural empowerment models of pedagogy are prescribed supports our view that the intellectual resources used, and expansively, serve purposes to do with the positioning

of a career academic or, in the case of ESM, of an attempt, perhaps, to mobilize resources that would help one resist and/or strengthen the image of researchers in the field as academic intellectual/researchers.

In conclusion, we would like to emphasise that there is a need to reflect on the theory and the method used in this research, and assess the whole approach as to its capacity to contribute to our understanding of the field and the field's location within the wider field of educational studies. It is also worth reflecting on the capacity of the field to raise and deal with wider issues of relevance to Education Policy issues today. Especially it is important to substantiate more and create a clearer picture of the actual achievements of the field's practitioners towards issues of equality and justice. This might entail a study of publications outside the mainstream journals. In addition, we believe that the recontextualisations of research texts to teacher education texts and the effects on teacher educators and teachers remains a most important area of further research, and whether the approach taken here can help direct research into this topic is worth exploring.

Furthermore we are concerned with creating a clearer picture about the impact of disciplines like mathematics on educational studies, for example towards its more *technical* turn (Tsatsaroni *et al*, in press), and understanding this requires us to work through both theoretical and empirical means.

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Appendices 1 and 2 can be found in a separate file

### Appendix 3

**Table 1. Theory type**

	PME				ESM				JRME			
	90 -95		96 - 01		90 - 95		96 - 01		90 - 95		96 - 01	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
<b>Traditional psychological &amp; mathematics theories</b>	49	73.1	49	60.5	52	63.4	49	51.6	34	54.8	44	57.9
<b>Psycho-social, including re-emerging ones</b>	8	11.9	8	9.9	8	9.8	19	20.0	4	6.5	10	13.2
<b>Sociology, Sociology of Ed, socio-cultural studies &amp; Historically orientated studies</b>	2	3.0	8	9.9	3	3.7	11	11.6	1	1.6	6	7.9
<b>Linguistics, social linguistics &amp; semiotics</b>	0	0.0	2	2.5	1	1.2	5	5.3	2	3.2	6	7.9
<b>Neighbouring fields of Maths Ed, science ed and curriculum studies</b>	1	1.5	0	0.0	0	0.0	0	0.0	1	1.6	0	0.0
<b>Recent broader theoretical currents, feminism, post-structuralism and psychoanalysis</b>	1	1.5	0	0.0	8	9.8	1	1.1	0	0.0	1	1.3
<b>Philosophy/philo of mathematics</b>	0	0.0	3	3.7	0	0.0	3	3.2	1	1.6	1	1.3
<b>Ed theory and research</b>	2	3.0	0	0.0	1	1.2	1	1.1	2	3.2	0	0.0
<b>Other</b>	0	0.0	0	0.0	1	1.2	1	1.1	2	3.2	0	0.0
<b>No theory used</b>	4	6.0	11	13.6	8	9.8	5	5.3	15	24.2	8	10.5
<b>Total</b>	67		81		82		95		62		76	

**Table 2 Methods**

	PME			ESM			JRME			Total
	<b>90-01 (135)</b>	90-95 (63)	96-01 (72)	<b>90-01 (139)</b>	90-95 (63)	96-01 (76)	<b>90-01 (122)</b>	90-95 (54)	96-01 (68)	<b>90-01 (396)</b>
<b>Qualitative</b>	<b>63.7</b>	69.8	58.3	<b>62.6</b>	49.2	73.7	<b>41.0</b>	29.6	50.0	<b>56.3</b>
<b>Quantitative</b>	<b>16.3</b>	11.1	20.8	<b>15.8</b>	28.6	5.3	<b>43.4</b>	57.4	32.4	<b>24.5</b>
<b>Combined</b>	<b>20.0</b>	19.0	20.8	<b>21.6</b>	22.2	21.1	<b>15.6</b>	13.0	17.6	<b>19.2</b>

**Table 3 Addressees**

	<b>PME</b>	<b>%</b>	<b>ESM</b>	<b>%</b>	<b>JRME</b>	<b>%</b>
<b>Researchers</b>	12	<b>8.1</b>	35	<b>19.8</b>	15	<b>10.9</b>
<b>Researchers &amp; Teachers</b>	112	<b>75.7</b>	128	<b>72.3</b>	91	<b>65.9</b>
<b>Researchers and teacher Educators</b>	18	<b>12.2</b>	10	<b>5.7</b>	20	<b>14.5</b>
<b>Reseachers and Policy makers</b>	6	<b>4.1</b>	4	<b>2.3</b>	12	<b>8.7</b>
<b>Total</b>	<b>148</b>		<b>177</b>		<b>138</b>	

**Table 4 Pedagogical model**

	PME		ESM		JRME		Overall	
	No.	%	No.	%	No.	%	No.	%
<b>No. of papers that have a pedagogical model</b>	124	<b>83.8</b>	151	<b>85.3</b>	123	<b>89.1</b>	398	<b>86.0</b>
<b>No. of papers without evidence of a pedagogical model</b>	24	<b>16.2</b>	26	<b>14.7</b>	15	<b>10.9</b>	65	<b>14.0</b>
<b>Total</b>	148		177		138		463	