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Grading Mathematics Education Research Journals

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Presentation of the project and initial motives

Nowadays, all researchers are aware of the increasing importance accorded to the ranking and grading of scientific journals; it is now difficult to escape their influence. The systems that currently exist are often based on crude statistical analyses that have little to do with scientific quality (see, for example, Arnold & Fowler 2011). For these reasons, the Education Committee of the European Mathematical Society (EMS), together with the Executive Committee of the European Society for Research in Mathematics Education (ERME) and supported by the International Commission for Mathematical Instruction (ICMI), decided in 2011 to organise a consultation in order to propose a grading of research journals in mathematics education based on expert judgment. A similar project has already been carried out for chemical education and science education journals (Towns & Kraft, 2011).

The approach adopted was to initiate a process which will need further elaboration and regular updating. For this reason, amongst many possible choices of method, we always opted for what appeared to be the most straightforward. We present below our methods and the results obtained.

Organisation of grading by experts

A working group, bringing together members of the ERME board and members of the EMS educational committee, was formed to take charge of the whole process. We (the members of this group) first prepared a long list comprising 49 journals. We graded the journals and compared our grades with the European Reference Index for the Humanities 2011 lists (https://www2.esf.org/asp/ERIH/Foreword/search.asp). This led us to retain a shortlist of 28 journals (all the mathematics education research journals mentioned as international on the ERIH list have been kept).

At the same time we constituted a panel of 91 experts in the field, representing the 42 countries members of the EMS and the ERME. Each country was represented by one to seven experts, according to the size of the mathematics education research community in each country.

These experts were contacted and asked to grade the journals, using the scale presented below. They were also invited to formulate any comments they wished to make on the process and to suggest other journal titles if they considered that important journals were missing from the list.

Criteria

The experts were invited to grade the journals on a four-point scale: A*, A, B or C, or to declare that they did not know the journal and code it with an X. The scale was defined according to four dimensions, characterising each rank: recognition; review process and quality standards; editors and editorial board; and citations. For example, the ranks A and B are described as:

A
- Recognition: The journal is recognised amongst researchers around the world as a strong one in the field of mathematics education.
- Review process and quality standards: Through a systematic process of peer review the journal maintains high standards with a view to publishing research that displays the intellectual rigour, originality and significance that will be recognised as making a valuable contribution to the field.
- Editor(s) and editorial board: The editor(s) and the members of the editorial board of the journal are themselves highly regarded researchers, many already recognised as international leaders in the field of mathematics education.
- Citations: The journal is regularly cited in other journals, and many high quality research publications in mathematics education make some reference to work published in it.

B
- Recognition: The journal is recognised by researchers around the world as an estimable one in the field of mathematics education.
- Review process and quality standards: Through a process of peer review the journal sets standards of rigour, originality and significance that command international respect within the field.
- Editor(s) and editorial board: The editor(s) and the members of the editorial board of the journal are themselves well regarded researchers in the field of mathematics education.

Answers and statistical choices

We received answers from 75 experts, representing 32 countries. In some answers, certain responses were missing; we replaced these by "X". A few experts proposed letters such as "D"; we replaced these with "C".

We decided to:

- Confirm a grade A* for all the journals rated A* by 50 experts or more (at least two thirds of the experts).
- Confirm a grade A (, B, C) to all the journals rated A (, B, C) or better by 50 experts or more (at least two thirds of the experts).
- Withdraw from the list all the journals that have more than 25 marked X (more than a third of the experts declare that they do not know the journal).

Some experts proposed additional titles. Nevertheless, no title was proposed by more than 8 experts; we thus decided not to add titles to the list.

Results

Following these principles: two journals received a grade A*; five journals received a grade A; five journals received a grade B; and five journals received a grade C. Eleven journals were removed from the initial list of 28 because more than 25 experts declared that they did not know these journals.

The following table presents the final results of the grading process.

Grade	Title
A*	Educational Studies in Mathematics
	Journal for Research in Mathematics Education
A	For the Learning of Mathematics
	Journal of Mathematical Behavior (The)
	Journal of Mathematics Teacher Education
	Mathematical Thinking and Learning
	ZDM: The International Journal on Mathematics Education
B	International Journal of Mathematical Education in Science and Technology
	International Journal of Science and Mathematics Education
	Mathematics Education Research Journal
	Recherches en Didactique des Mathématiques
	Research in Mathematics Education
C	Canadian Journal of Science, Mathematics and Technology Education
	Journal für Mathematik-Didaktik
	Nordisk matematikkdidaktikk / Nordic Studies in Mathematics Education, NOMAD
	Technology, Knowledge and Learning (formerly: International Journal of Computers for Mathematical Learning)
	The Montana Math Enthusiast

Limitations of the grading process and need for further studies

Naturally, this process has a number of limitations. We note some, here, that we discussed during our work and which were also expressed by some experts in their comments.

- A grading produced by European experts risks being Europe-centric.
- Only journals overtly focused on mathematics education have been included. Journals about education at large are also very important for the researcher in the field and are not mentioned in the list.
- The list contains mainly journals written in English.
- Journals about more specific topics, such as statistics education in particular, are unknown to many experts but may be of high scientific quality.

All these remarks correspond to real limitations of our study. They evidence the need for further studies: ICMI could decide a similar grading at a worldwide level and, equally, more local initiatives could better recognise journals in languages other than English, or with specific foci. The scientific quality of journals is always evolving; a change in the reviewing process, for example, can lead to an improvement of a journal. Thus any grading should retain the possibility of updating and evolution; the grading proposed here is presented as our best attempt at assessing the current situation.

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Time Lag in Mathematical References

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Results in mathematics do not just hold forever – we are also conscious of them for a long time. The Pythagorean Theorem still taught in schools may be an extreme example but also, in our specific research fields, specialists are usually aware of long-lasting conjectures which have influenced centuries of research or seemingly dead areas revived when looked upon by a new generation from a different angle.

Unfortunately, this very fascinating attribute of mathematical research has turned out to be a handicap in the scientometric age. When measures like impact factors came into use in the second half of the 20th century, they were initially limited to very recent data for very practical reasons: critical masses of references were generally not yet available or manageable for longer periods of time. As an effect, the computation of the usual impact factor is restricted to two years (some extensions go to the limit of at most five years). But what is lost? This leads to the natural question of the time lag for mathematics references, i.e. the average difference of the publication year of the citing and the cited article.

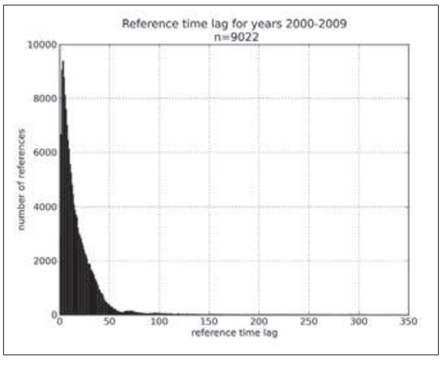
Surprisingly, this is not a question that is easy to answer. In an earlier issue, Rui Loja Fernandes[1] gave a good illustration in the example of the evaluation of the IST: Table 5 on p. 16 shows that both the aggregate cited and citing half-life in mathematics is longer than ten years on the sample of mathematics reflected in the ISI data. The recent progress of digital libraries over the last two decades contributes hitherto unavailable data to the pool and allows at least some glimpses into how mathematical information is alive through the decades.

Here, we start from two data sets which became only recently available: references extracted during the development of the European Digital Mathematics Library (EuDML)[2,3] and the set of references currently stored and identified in the zbMATH database.

Both sets are not ad hoc comparable: EuDML represents, with about 200,000 entries, a fraction of the literature now available in the public domain. For 44,817 articles (greater than 20%), references are now extracted from the digital full text but the data comes with the natural inaccuracies of automatic processing. Naturally, most of the cited articles are not contained in EuDML itself. On the other hand, the (about) 166,305 articles with references in zbMATH are a considerably smaller fraction of the total, greater than 3.2 million, items (just greater than 5%) but come along with the advantage of being mostly matched against the database, hence providing more accurate information.

However, there are also striking similarities: for both data sets, there are virtually no citing articles before 1890 and only very scarce cited articles before 1850. There is no surprise here. By now, references must obey at least rudimentary patterns (author, title, source, publication year) to be detected. This only came along with the appearance of scientific journals in larger numbers. (Note that the volumes of Euclid's *Elements* are rarely cited with their precise publication years).

Hence, when ignoring sparse data, we have a 120×140 years citation matrix, with zeroes below the obvious diagonal. (Actually, this is not so obvious in the case of zbMATH data: contrary to EuDML, there are several cases of negative time lag, which comes from the fact that "submitted/to appear"-articles in the references were identified in their final version in the zbMATH database, with a possibly delayed publication year. But this pertains to less than 0.1% of the references.) For easier representation, these data were grouped by decade of the citing articles; the typical picture can be seen below.



Publication years of references of EuDML articles published 2000–2009; typically, the numbers can be approximated by a power law distribution.

1 Evaluation of Faculty at IST – a Case Study. EMS Newsletter 84, 13–17.
2 http://eudml.org.
3 EMS Newsletter 76, June 2010, 11–16; ibid. 85, 57–58.