

Plenary 2: Wednesday 8th July 2009

The problem field of Adults Learning Mathematics

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In the borderland between mathematics education and adult education a new research field was cultivated, and an international research forum was formed in the 1990's: Adults Learning Mathematics. The subject area encompasses formal adult mathematics education as well as adults' informal mathematics learning in the communities of everyday practice. The key concept is numeracy and the problem field is related to adults, mathematics and lifelong education. This paper presents a current picture of international research in adults learning mathematics. Three examples of research and developmental projects related to adults engaged in specific social practices are given: parents, landless peasants, and nurses.

The emergence and growth of the field

In the 1990's, "adults learning mathematics" was cultivated as a new field of research in the borderland between mathematics education and adult education. The subject area includes formal adult mathematics education as well as adults' informal mathematics learning in the communities of everyday practice. Some of the key words are globalisation, exclusion, equity and participation, and also technological and economic development. The background for the emergence and growth of the field is located in two parallel and combined processes linked to the idea of lifelong learning: *an institutionalizing process*, where schools or colleges for adults become subject to the same kind of regulation as schools for children and adolescents; and *a de-institutionalizing process* where the focus is on adults' learning processes outside schools, e.g. in workplaces (Wedege, Evans, FitzSimons, Civil, & Schlöglmann, 2008).

The international research forum *Adults Learning Mathematics* (ALM) was formed in 1994 and I find this event decisive for the growth into a field of what were until then sparse research activities. The starting point of ALM was the article "What do we need to know" written by Diana Coben in the UK. She pointed out the main problem to be the missing contact between adult numeracy teachers and researchers in adult and/or mathematics education. Coben stated that there were several reasons for this: the difference between the culture and ethos of academic research and that of adult numeracy (the culture clash); the perceived difficulty of mathematics as the subject-matter of numeracy (the subject problem); the lack of relevant research; the lack of a forum for researchers and practitioners (a numeracy forum). That is also why the research forum ALM welcomes practitioners as well as researchers (see www.alm-online.net). In 1996, this upcoming research field was introduced within the field of mathematics education research by the publication of a chapter in the International Handbook (see below) and a working group at the 8th International Congress on

Mathematics Education (ICME-8). In the introduction to the proceedings of ICME-8 (G. E. FitzSimons, 1997), Alan Bishop wrote “as research and development grow here they will challenge some of the established ideas from what one might think of as ‘mainstream’ mathematics education, namely school mathematics education” (p. 3). However, until now, only very few of the publications from ALM members have been quoted heavily in ‘mainstream research’. Among these are Jeff Evans’, “Adults’ mathematical thinking and emotions” (Evans, 2001).

Some research issues spotted by Coben (1992) were maths anxiety, gender and maths, and maths implicit in traditional crafts of many cultures. Also at the beginning of the 1990’s, Iddo Gal (1993), from another part of the world, called for research in his report “Issues and challenges in adult numeracy”. He stressed that research is lacking in most areas related to numeracy provision and points out some key areas, for example: factors affecting the transfer of numerical skills from the classroom to actual practice; how adults’ everyday experiences and knowledge (e.g. with handling money or consumer transactions) can be used to facilitate learning; the impact of an adult literacy programme on learners’ beliefs and attitudes towards mathematics (p. 44). In both documents arguing for the necessity of research in adult learning mathematics/numeracy, the so-called “transfer” of mathematics between school and the everyday and vice versa is questioned. But as Evans (Evans, 1999) and Wedege (1999) among others have shown this is not a “straightforward affair”.

In this paper, I present a current picture of international research in adults learning mathematics where numeracy is the key concept. The focus is on the interplay between research and education, and three examples of research and developmental projects related to adults engaged in specific social practices are given: parents, landless peasants, and nurses.

Numeracy: building bridges

In ALM research, the key concept is *numeracy* and the problem field is related to adults, mathematics and lifelong education in a societal context. Strictly speaking it is a not correct to talk about “the concept of numeracy” because numeracy is a contested notion and there are a long series of different and still possible definitions. (See for example the definitions compiled by David Kaye in “Defining numeracy” – a selection of definitions” (Kaye, 2002)). However, across this diversity, in many definitions a wish to solve the problem of “transfer” or of “transmission” raises the idea of numeracy bridging between mathematics and adult life. This notion was drawn from a critique of mathematics education:

Frustrated with a mathematics whose history kept it within strong disciplinary boundaries (...) We colonized numeracy, permitting, indeed requiring, it to be a bridge between mathematics and society (Johnston & Yasakawa, 2001, p. 291).

The idea of bridging between mathematics and the real world was also a basic idea in the international Adult Literacy and Life Skills survey (ALL) where a series of active ALM members have created the numeracy framework:

Our basic premise is that numeracy is the bridge that links mathematical knowledge, whether acquired via formal or informal learning, with functional and

information-processing demands encountered in the real world (Manly, Tout, van Groenestijn, & Clermont, 2001, p. 79).

The theme of bridging mathematics and adult life is also thematised in John O'Donoghue's key note "Mathematics or numeracy: Does it really matter?" at ALM-9 (O'Donoghue, 2003), and it lies implicitly in Gail FitzSimons's key note, "An Overview of adult and lifelong mathematics education", at ICME-10, where she argues that the construct of numeracy is an example of a horizontal discourse, in contrast to the vertical discourse of mathematics (G. E. FitzSimons, 2004). To finish this very brief discussion, I shall give an example of a definition which illustrates two more common characteristics (functionality and contextuality) that can be recognised in the different constructions of numeracy:

Numeracy consists of functional mathematical skills and understanding that in principle all people need to have. Numeracy changes in time and space along with social change and technological development (Lindenskov & Wedege, 2001, p. 5)

Research reviews: some examples

From the mid 1990's and onwards, we have a series of international reviews of the research in adults learning mathematics. In the first *International Handbook of Mathematics Education* from 1996, there was a reference to "adults" for the first time ever in a reference work on mathematics education research. The authors presented adult numeracy and characterized the field as one showing "great heterogeneity". They identified two approaches to adults' mathematical knowledge: one relates to school mathematics and the other to non-educational contexts (G. E. FitzSimons, Jungwirth, Maasz, & Schlöglmann, 1996). In the second international handbook from 2003, there was a chapter exploring adult lifelong mathematics education as contextualised from social, cultural, political and economic perspectives, and adult mathematics education was presented as a research domain (FitzSimons, G. E., O'Donoghue, J. & Coben, 2003).

We find a comprehensive review of international research on adult numeracy in D. Coben et al., 2003. Here the field is presented as fast-developing but still under-researched, under-theorised and under-developed. Some of the headings in the report are 'Numeracy in context', 'Learning and teaching numeracy', 'Factors affecting learning', and 'What do we know and what do we need to know about adult numeracy'. This review was produced and published in the UK. A couple of years later, a review of the literature in adult numeracy was published in the US (Condelli et al., 2006). The report was based on a series of research questions posed by the Office of Vocational and Adult Education and it was structured by four issues: conceptualizing adult numeracy; adult numeracy and mathematics instructional approaches and interventions; and assessment and professional development in adult numeracy.

Recently, I have written a local review "Adults learning mathematics: research and education in Denmark" for a book on Nordic research in mathematics education. In this article, the Danish research and researchers are situated within the international community of ALM. The key issues in the overview are: what mathematics do adults know in the workplace; why do adults (not) learn mathematics; why teach mathematics to adults; and how to teach or what is "best practice" in adult mathematics education?

The scope of the literature review

In this paper, I intend to present a current picture of international research in adults learning mathematics with examples from the interplay between research and education. The title of the paper is “The problem field of Adults Learning Mathematics” and the key word in my analytical framework for this review is “problem field”. In order to ground the picture of international research and my choice of research and developmental projects for this paper, I have done a literature review. The scope is defined by the research field which is reviewed and the terminological framework which is used to demarcate and to structure this field for the purpose of the review (Wedegge, 2001) (Wedegge, 2010). As a starting point educational research is defined in general as “a process of *systematic inquiry* that is designed to collect, analyse, interpret, and use *data* to understand, describe, predict, or control an educational (...) phenomenon or to empower individuals in such contexts” (Mertens, 2005, p.3). This general definition is consistent with a view, which I share, of mathematics education research as “the collective effort to study and to shape the relationship between humans, on the one hand, and mathematics on the other” (Fischer, 1993, p. 113) in society.

What is studied in the field?

By *subject area* I mean the phenomena to be investigated in research. This area is distributed between adults, education and mathematics and it is always-already (toujours-déjà³) structured and delimited by the concrete forms of practice and knowledge that are currently regarded as adult mathematics teaching, learning and knowing. In the topic study groups at the ICME congresses in 2004 and 2008 adults were defined with implicit references to the two processes mentioned in the introduction, respectively the institutionalizing process and the de-institutionalizing process:

Adults is interpreted as referring to people who start, resume or continue their education in formal, informal or non-formal settings, beyond the normal age of schooling in their societies (TSG8 ICME11 <http://icme11.org/>).

Adults are engaged in a range of social practices, such as working (or seeking work), parenting and caring for other dependants, budgeting and organising consumption, voting, etc. (TSG6 ICME10 www.icme10.dk).

Within the field, mathematics is given a broad definition:

By *mathematics* we mean multiple activities and knowledge, including academic mathematics, vocational mathematics, ethnomathematics, folk mathematics and adult numeracy (TSG8 ICME10).

The term *lifelong* indicates that education and learning takes place at all stages and in all spheres of life. Regarding *education* the terminology of UNESCO (2000, p. 41) is often adopted: *Informal education* means the lifelong process whereby adults are learning mathematics in everyday life (e.g., work, family, leisure, society). *Formal education* refers to the adult educational system from adult basic education and vocational training through to further and higher education. *Non-formal education* is defined as any

³ A French structuralist term

educational activity organized outside the established formal system that is intended to serve identifiable learning objectives.

Who are the researchers?

The review spans sources (English in original or translated into English) covering international research judged to be relevant to adults learning mathematics, mainly adults with short formal educational stories: *ALM proceedings* (1-15), *Adults Learning Mathematics – An International Journal* (ALMIJ), *ICME proceedings* (8-11); international mathematics education research journals (1999-2008) (*Educational Studies in Mathematics*, *Journal for Research in Mathematics Education*, *For the Learning of Mathematics*, *ZDM – The International Journal for Mathematics Education Research*). Priorities of the research review are based on explicit criteria for relevance and quality. For the presentation at the conference, I put together a list of outstanding researchers within the field, on the basis of three objective criteria:

- i. *Quantity* – number of research papers/articles/reports published
- ii. *Quality* and relevance – place of publication (publication in refereed ALM proceedings, ICME proceedings, ALMIJ, other international journals)
- iii. *Relevance* and quality – citations (apart from the author’s self citation) within the community of ALM defined as citations in ALM-proceedings, ICME proceedings, ALMIJ and the international research reviews mentioned above.

People who have presented a research paper at two or more ALM conferences (1-15) and/or in ICME 8-11 Topic Groups were on the gross list of 50 researchers to whom I applied the three criteria to form the top list in the next step.

Alphabetic top 19 list of researchers in ALM

Roseanne Benn	Mieke van Groenestijn	Wolfgang Schlöglmann
Marta Civil	Mary Harris	Alison Tomlin
Diana Coben	Gelsa Knijnik	Dave Tout
Jeff Evans	Betty Johnston	Tine Wedege
Gail E. FitzSimons	John O’Donoghue	Keiko Yasukawa
Iddo Gal	Kathy Safford-Ramus	
Lynda Ginsburg	Analucia D Schliemann	

Besides their academic contribution to the field, 15 of the researchers on the list have been active in organizing and further developing the international research forum ALM as members of the trustees group of ALM, members of the editorial team/board of ALMIJ and/or chairing ICME groups or ALM conferences.

From subject area to problem field and *problematique*

I have often quoted the French epistemologist, Gaston Bachelard ((1927)), for this fundamental statement: “The sense of the problem is the nerve of scientific progress”. When the subject area of “adults learning mathematics” is cultivated, research problems are formulated in a dialectic relationship with practice and the area is growing into a subject field. When the researchers explicitly start to locate and

formulate problems concerning phenomena within the subject area (adult, mathematics, education), then it is further structured and the *subject field*, i.e. the field which is actually investigated, is created. Taking their points of departure in a specific position, the researchers adopt a certain view of the subject and identify a *problem field* concerning the subject area by locating and formulating problems (Wedegé, 2001). In the ALM conference proceedings and in the first studies, during the first five years, a series of names and titles pop up all the time in the reference lists. These researchers formulate problems within the affective domain (adults' beliefs, attitudes and emotions towards mathematics) inspired by the following: *From failure to success: Changing the experience of adults learners of mathematics* (Burton, 1987); *Do you panic about mathematics?* (Buxton, 1981); *Overcoming math anxiety* (Tobias, 1993); *Relearning mathematics: a different third R-radical math* (Frankenstein, 1989); and at the end of the period: *Adults count too: Mathematics for empowerment* (Benn, 1997). Researchers also formulate other problems related to the issue of school mathematics versus everyday mathematics inspired by: *Cognition in practice. Mind, mathematics and culture in everyday life* (J. Lave, 1988); *Schools, Mathematics and Work*. (Harris, 1991); and *Mathematics counts* (Cockcroft, 1982).

During the first five years of ALM, many of the researchers formulate the problems within theoretical frameworks and perspectives mainly found in mathematics education research: *Mathematical enculturation*. (Bishop, 1991); *Philosophy of mathematics education* (Ernest, 1991); *Paulo Freire* (1972); *Pedagogy of the oppressed* (Freire, 1972); *Cognition in practice. Mind, mathematics and culture in everyday life* (J. Lave, 1988); *Situated learning: Legitimate peripheral participation* (J. Lave & Wenger, 1991); *Street Mathematics and School Mathematics* (Nunes, Schliemann, & Carraher, 1993); *Critical mathematics education* (Skovsmose, 1994).

The problem field of Adults Learning Mathematics

Adult and lifelong mathematics education has multiple dimensions and the approaches embrace, besides mathematics, a range of disciplines (psychology, sociology, politics, pedagogy, anthropology and androgogy), and a spectrum of concerns about inclusion – along the lines of gender, class, ethnicity, age and language group. In order to give a current picture of international research in the field of adults learning mathematics with a focus on the interplay between research and education, I have selected three problem fields related to adults engaged in specific social practices as parents, as landless peasants, and as nurses.

Working with parents

Why do adults return to study mathematics? In the English project *Making numeracy teaching meaningful to adult learners*, a central research questions was about students' motives for attending – and continuing in – adult numeracy classes. It was concluded that students' reasons for joining, and continuing to attend, numeracy classes are varied and complex (Swain, Baker, Holder, Newmarch, & Coben, 2005). One of the main triggers is to help their children with homework.

In 2008, the ALM International Journal had a special issue, Volume 3 (2a & 2b) on “Parents’ involvement in mathematics education: looking for connections between family and school”. Here are some of the key problems formulated:

- There is a connection between students’ performance in mathematics and parental engagement and family involvement.
- There is evidence that low-income families usually have fewer opportunities to engage in their children’s education than middle or upper class families.

The issue studied and discussed in this sub-field is how parents – in minority and working-class communities – become helpers of their children in doing mathematics. A key issue is the need to transform parents’ own perceptions about themselves as learners and doers of mathematics - expressed like this by Marta Civil: “Our goal is to develop teaching innovations in mathematics that capitalize on students’ (and their families’) knowledge and experiences from everyday life” (Civil, 1999, p. 216).

At ICME-11, in 2008, Javier Díez-Palomar et al., belonging to the new generation of researchers, was “Drawing from a parent’s perspective”. Díez-Palomar was also the guest editor at the ALM Journal special issue mentioned above. In the editorial introduction, he states the aim of the issue as developing “the perspective in the field of adults learning mathematics from the point of view of the work with parents who are learning mathematics” (Díez-Palomar, 2008, p. 6). The approach in this problem field is consistent with the work in ethnomathematics, and more specifically with the intersection of ethnomathematics and adult education as found in the work of Knijnik. At ICME-10, Civil (2004), in her presentation entitled “Parents as intellectual resources: Implications for adult education”, made a specific reference to Knijnik’s concept of ethnomathematical approach, as a combination of research into the conceptions, traditions, and mathematical practices of a specific subordinated social group and of pedagogical work involved in making the group members realize that:

1. they do have knowledge;
2. they can codify and interpret their knowledge;
3. they are capable of acquiring academic knowledge;
4. they are capable of establishing comparisons between these two different types of knowledge in order to choose the more suitable one when they have real problems to solve. (Knijnik, 1993, p. 24)

Landless peasants

Gelsa Knijnik (2007) problematizes the dichotomy between “high” and “low” culture in mathematics education on the basis of empirical data from field work with peasants from the Brazilian Landless Movement. In the mid-1990’s she formulated the problem like this:

A given social group, in this case the rural workers, practises a different mathematics from that produced by academia, and therefore not socially legitimate. How does one deal pedagogically with this cultural diversity, in this case mathematical diversity? (Knijnik, 1997, p. 89)

Knijnik (1997) acknowledges the ethnomathematical approach but, as we have seen, taking a socio-political position she makes different conclusions. The investigation of the traditions, practices and mathematical concepts of the landless peasants and the pedagogical work which is developed in order for them to be able to interpret and decode their knowledge; to acquire the knowledge produced by academic mathematics; and to establish comparisons between the two kinds of mathematical knowledge, thus being able to analyse the use of the two kinds of knowledge and the power relations involved.

Numeracy for nursing

The main problem pointed out in relation to the social practice of nursing is that poor numeracy can be life-threatening for the patient. It was stressed by Meriel Hutton at ALM-4:

That nurses need to be competent in the mathematics involved in calculating fluid balance, drug dosages and intravenous drip rates is generally accepted. **However**, nursing students have been shown to perform poorly in written tests of the relevant mathematics. (Hutton, 1998, p. 192)

Ten years later this problem is reformulated by Diana Coben and her colleagues (2008) at ALM-14. They state that numeracy is recognised as a key skill for professional practice in nursing and they refer to successive studies which present a picture of lack of proficiency within both the student population and amongst registered nurses. Furthermore, they point to another problem. There is no recognized standard for numeracy for nursing with the consequence that it is difficult to determine which skills require development, or to ascertain when competence has been achieved. However, the body regulating the profession in the UK requires nursing students to achieve 100% in a test of numeracy in practice before they are allowed to register as nurses. Hence, Coben (2010) argues that a multiplicity of tests, processes and criteria, which may be neither reliable nor valid, are being developed and deployed in pre-registration nursing programmes throughout the UK. These are some of the problems that two big research and developmental projects intend to solve by creating a benchmark for numeracy for nursing.

In the nursing project a new discourse has entered the scene of ALM. While the predominant position – as a starting point – has been to perceive adults as competent parents, peasants etc., the main concern here is the lack of nurses' proficiency. I find that the challenge for ALM research and education is to combine general requirements for qualifications in society with adults' competences and subjective needs (Wedeg, 2001).

Perspectives

In mathematics education research, over the last 30 years, there has generally been a shift in focus and interest from teaching via learning to the teacher (education, practice, identity). The main research concern in ALM has been adults knowing and learning mathematics/numeracy, but the importance of the professional development of teachers in adult numeracy education has been on the agenda from the beginning, for example represented by the Australian team Betty Johnston, Beth Marr and Dave Tout (see Marr & Tout, 1997). However in a recent research review on teacher

education in adult literacy, numeracy and ESOL, where Terry Maguire is responsible for the numeracy part, the authors conclude:

While this review has surveyed a rich literature in adult, further and higher education, it is noticeable that the subject-specific literature on learning to teach on initial teacher education programs, (...), is not replicated in the world of adult literacy and numeracy education. (Morton, Maguire, & Baynham, 2006, p.59)

Another absence of research that I want to stress in this overview is the gender perspective. At the ALM conference in 2001, Inge Henningsen (Henningsen, 2002) called for research with this perspective arguing the need for gender as an important, explicit and independent factor. However, the call for papers for a special issue on gender in ALMIJ 2007 resulted in only three accepted articles in volume 3(1). I take this fact as evidence of a general missing interest in the gender aspect of adult mathematics education.

In the introduction, I quoted Bishop who said in 1996 that the development and growth of the ALM research field would challenge some of the established ideas coming from ‘mainstream’ mathematics education. Since then, the research field has grown in quantity and quality and ALM established an international journal in 2005. However, it seems to be difficult for the journal to increase the number of submitted articles. In 2009, there was only a single issue with three articles. Furthermore, it appears that the articles on adults and mathematics in the international journals are in general few and far between. I do not find that this is a healthy situation and I suggest to the research forum to debate whether the researchers should concentrate on the ALM journal or rather on producing a special issue of “ZDM – The International Journal for Mathematics Education Research” to show the world what ALM research is about and why it is a challenge for ‘mainstream’ mathematics education.

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