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Introduction to TWG07 Adult Mathematics Education

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This paper is a summary paper of the Thematic Working Group (TWG) on Adult Mathematics Education (AME). As the only thematic working group that focuses on adults' lived experiences of mathematics, the research makes an important contribution to the field of Mathematics Education. The main themes in this group identify that adult numerical behaviour goes beyond the mathematics skills, knowledge, and procedures taught in formal education. It is multifaceted, requiring the use of higher order skills of analysis and judgement, applied within a broad array of life's contexts, experienced through a range of emotions. The research in this group points to the need to raise the profile of research that shows the benefits to adults of learning mathematics but also the long term economic disbenefits in the neglect of teaching and teacher training for this group.

Keywords: Adult Mathematics Education, Numeracy, PIAAC,

Introduction

One thing the pandemic has taught us is that understanding mathematics and its role and influence on peoples' lives really matters. Every day we were shown graphs and charts indicating trends that were used to make predictions about the world's health and economic situations with significant implications on our individual behaviour. We were shown countless exponential graphs, numbers in the billions and given numerical risk analyses of actions, which increased the demands on our mathematical interpreting, understanding, and reasoning to make sensible decisions on our behaviour with huge impact on our lives. Yet the mathematics being learned in schools seemed to be reduced in content and unequal in access (Hodgen, Taylor, Jacques, Tereshchenko, Kwok, & Cockerill, 2020), distant from what was needed to help understand the situation.

Hoogland and Díez- Palomar (2022, this publication) argue that society is becoming increasingly mathematised, and the demands on adults to make numerate decisions that impact on their lives is considerable, yet interest in research into the world of adults learning mathematics and life-long learning lacks attention. This is already a long-lasting problem. Coben (1994) argued interest in research into adult numeracy only started to be recognised for its importance when she highlighted the differences in cultures between academic research and those involved in adult numeracy and mathematics education. Reinforcing the idea that adults learning mathematics was different from school based mathematics, Withnall (1994) further argued rather than it being a set of mechanistic, isolated mathematical skills which can be acquired free of context and then applied to real life, numeracy is better understood in relation to the demands on adults' lives in their broader contexts, where communication skills are key to interpreting the variety of 'mathematical codes' encountered and on which we are asked to exercise judgement to ensure a useful outcome.

Since then, with nearly 30 years of research plus the establishment of a global forum Adults Learning Mathematics (ALM), practitioners and researchers have been exploring their understanding of adults' ability to learn and utilise mathematical information. In response to economic, social, and technological changes, our understanding of the field of adults learning mathematics has developed, yet still many citizens lack the numeracy competencies to enable them to fully participate (Gal, Grotlüschen, Tout & Kaiser, 2020; Hoogland & Díez-Palomar, 2022, this publication; Yasukawa, Rogers, Jackson, & Street, 2018) and few trust numbers enough to deal with, let alone challenge, a world in which fake-news can flourish. These factors have profound implications for the way in which numerical skills are taught and learnt in adult education programmes.

Emerging themes in Adult Mathematics Education

The content of this working group requires us to consider the notion of numerate behaviour in its widest sense, exploring a range of ideas, contexts and applications, probing further the relationship between numeracy and mathematics.

Contributions focus on:

- Reflecting on the field of adult numeracy and its relationship with mathematics.
- Numeracy as a lived experience of mathematical calculations and procedures in social economic and political contexts.
- Developing numeracy and mathematical skills with adults, including vocational education.

These themes reinforce the need to recognise that adults' experiences with mathematics inform judgements affecting their lives far beyond the classroom. The breadth of papers in this working group reflects the wide scope of the field of Adult Numeracy. The single working group focused on adults' mathematical experiences in this CERME 12 conference points to an important contribution that the understanding of adults' lived experiences of mathematics, both inside and outside formal state sponsored education systems, adds to our understanding of Mathematics Education. Adults and their numeracy skills are intertwined with the political, social and economic systems, are shaped by, but also shape those lived experiences (Lerman, 2000). In the next paragraphs we introduce the papers outlining the contributions to the three areas of focus.

Reflecting on the field of adult numeracy and its relationship with mathematics

Kaye, past chair of ALM, discusses the historical development of the concept of numeracy. Taking a philosophical view, using Thomas Kuhn's notion of lexicon and incommensurability, Kaye likens the development of the field of adult numeracy to a paradigm shift. Emerging from the field of mathematics education research, almost in a Darwinian sense (Kuhn, Conant, & Haugeland, 2000, p 98-101), responding to historical, environmental, and social changes. Kaye seeks to research the notion of adult numeracy using Kuhn's paradigm shift. He argues for the need to find agreement in the concepts of what numeracy is, so that it can be utilised to critique mathematics research. Although he concedes that many languages do not have a word for 'numeracy', he maintains many countries and contexts have similar adult learners in similar situations with similar numerate behaviours.

Diez- Palomar and Hoogland (2022, this publication) undertook a literature review into the field of adult numeracy over the last 20 years, to identify the topics investigated and where gaps have

appeared that could point to new lines of enquiry. The main findings suggest research most often cited focused on the contexts of health and social care, followed by articles on numeracy in everyday life. Most higher order skills cited were processing information, problem-solving and critical thinking. Most of the cited articles were based on quantities and numbers, perhaps not surprisingly given the time span, few studies focused on apps or digital skills. When considering dispositions most focused on self-confidence.

It is apparent that while many within the field of adult numeracy research are aware of important contributions, the work is less well known outside this field and so work needs to be done to raise the visibility of our research in other domains and with policy makers. Increased visibility is important to inform policies on adult mathematics education, with as main focal point the idea that numeracy is a multi-faceted concept.

Adult numeracy is more than mathematical skills, knowledge, and procedures taught in schools. It is complex encompassing higher order skills, applied to a broad range of contexts, experienced through a range of emotions. The Common European Numeracy Framework (CENF) by Hoogland and Diaz-Palomar (2022, this publication) brings up to date our understanding of what society requires from adults. They identify four aspects to numerate behaviour. Suggesting adults need to be able to recognise and apply appropriate mathematical concepts but within many different everyday contexts; to use higher order skills to process, reason and analyse the numerical information that influences decisions affecting their daily lives. All of this while recognising adults have many beliefs and feelings related to mathematics itself, developed through lived experiences, which will affect their judgement when dealing with numbers. Spiegelhalter (2017) also writes about this in relation to the notion of 'trust' in numbers when surrounded by fake-news. The CENF illustrates a way to research aspects of the field of adult numeracy encompassing the lived experience of mathematics education. Hoogland and Diez- Palomar further point to the increased 'mathematisation of society' through technological developments, where people must make numeracy-based decisions all day long. While arguing that equipping people with the necessary skills will be a big challenge, they posit this will require us moving away from 'mastering the execution of calculations with pen and paper to recognising numeracy as a multifaceted concept needed for the 21st century'. Work related to the CENF framework will, in the future be linked with PIAAC as well as the development of teaching resources and professional development modules, to help disseminate the ideas further.

Numeracy as a lived experience of mathematical calculations and procedures, in political, economic, and social contexts

Kelly, (2022, this publication) chair of ALM, explores the financial literacy skills and knowledge needed to survive in complex financial systems. She uses the notion of financial vulnerability (Gal et al, 2020) to research the extent of global economic need, the impact of western economic systems, community influences and individual risk factors. She identifies financial vulnerability as a global issue, affecting women more than men, arguing that this has a lot to do with societies' gendered expectations of female and male roles. Other vulnerable groups include those who are disabled, single parents and people living in marginalised communities, and the COVID pandemic has made life more difficult for those already financially squeezed. Mathematical calculations, such as interest, are key

to understanding many financial concepts. But making sound financial judgements in real life also requires the ability to analyse, and reason what those interest rates mean, for example, when taking out loans. She found most current national child-focused financial education resources in the UK focus on dispositions towards money considering psychological and emotional relationships with money and mathematics. While adult numeracy skills and knowledge are essential to making sound judgements in financial decision-making, so are literacy and digital capability skills as well as understanding emotional attachments. Kelly argues that financial literacy education can be seen as one way to combat financial vulnerability but to be effective needs to focus on learners' priorities.

Byrne and Harrison (2022, this publication) give an insight into numeracy education in prisons, a particular but very important context within society. Mathematics education in prison is a basic life skill (Council of Europe, 1990) yet Byrne and Harrison found it varies considerably across countries and within national systems. Despite this variation the Mathematics in Prisons (MiP) group was established by two practitioners, one in Ireland and one in the USA, whose research focus is centred upon those learning mathematics within the 'secure estate'. Prisons over the centuries have been seen as agents of the state to reform, to penalize, to encourage desistance from crime, and more recently to encourage lifelong learning and personal transformation. The MiP group shares the later goals and explores similar experiences in the maths classrooms. All tutors work with students who may not have chosen to study mathematics were they not in prison. Yet Byrne and Harrison found this experience can encourage reflection and become a turning point in an individual's life, as mathematics is a gateway to further and higher education. The MiP group plans to support those working across international boundaries, overcoming the challenges of variation in language and culture, exploring the value of learning mathematics for different groups and aim to use this CERME platform to further raise awareness of the group and to recruit members.

Dulam and Hoogland (2022, this publication) utilise the large database provided through PIAAC to explore numbers in an economic context examining the consequences of a mismatch between workforce skills and employment on the economy. At individual (micro) level, where skills-mismatch can lead to lower job satisfaction and wages. At company (meso) level where mismatch leads to a higher staff turnover and inefficiencies and at a country (macro) level, leading to unemployment, lower productivity, and lower economic growth mainly due to wasting human capital (OECD, 2013).

They find skill levels vary over time in adults' lives and with employment opportunities. But they also question how reliable the actual measurements of over and under skill levels are. In their research they found being over-skilled for a job is more likely for men, younger age-groups, those with higher education, and for people who use their numeracy skills often at work. Also, the likelihood of being over-skilled increases as the frequency of using numeracy skills at work increases. Further consideration needs to be made to fully appreciate the implications of some of the findings. For example, employing over skilled men might be due to an inbuilt gender bias within certain job roles and industries where males are more likely to be employed over females, which would affect a skills mismatch. Also, some countries' employment policies are attached to certain financial penalties which are imposed if people do not accept employment offered, consequently this can 'push' over-skilled people into lower skilled jobs.

Exploring context as a broader notion of democracy Lindenskov (2022, this publication), considers the skills and knowledge essential to understanding how mathematical thinking underpins the very essence of our political and social systems. She argues that mathematics underpins our lives both inside and outside education, in both formal and informal ways. For example, using the same numbers but comparing election outcomes in countries that use ‘first past the post’ algorithms with those using a proportional representation system. Lindenskov argues that such exercises give a better understanding of how mathematics shapes our parliaments, our laws and our lives. She further posits democracy can influence the classroom through the teaching approaches used, as well as the topics covered. This links back to the role that numerate behaviour has in adults’ lives going beyond the classroom, and how research into the field of numeracy helps us better understand how mathematics can inform, influence, and empower adults’ daily lives.

Developing numeracy and mathematical skills with adults, including vocational education.

Investigating mathematics education with adults and different aspects of the mathematical skills and knowledge of teachers and their students is a rich source of research into adults learning mathematics. This section points to several gaps in teacher training and continuing professional development courses for those involved with mathematics education for adults, especially those asked to teach numeracy to adults but without the specialist knowledge to support their endeavours. Is it any wonder that results from PIAAC and OECD surveys show that in all but one participating country, at least 10% of the adults are proficient below level 1 of the 6-point scale in literacy or numeracy (Hoogland, Kelly & Díez-Palomar, 2019, p.1294)?

Bradtke and Ferri (2022, this publication) explore the mathematical competence of vocational teachers whose main subject is economics, comparing prospective teachers who have mathematics as a subject in their curriculum with those who have not. In their research they found that most vocational teachers did not receive any mathematical training in their studies, although they use, among other things, the percentage calculation in business lessons. In a pilot study, an instrument was validated to record whether the mathematical model of compound interest is recognised and successfully applied in different situations, by the two groups of teachers. The results showed that even student teachers with mathematics as a subject have difficulties with its application to the economic problems. This is interesting when reflecting on the importance of understanding and applying percentage calculations at a global level to economic growth figures, but also to more individual financial decision-making when applied to making interest payments on savings and credit. It points to an important deficiency in education systems that can have serious widespread repercussions, where teachers’ lack of mathematical understanding is passed on to the students, known in economic terms as the multiplier effect.

Responding to a national push for problem-solving to be introduced into the mathematics taught in schools and colleges in order that it can be utilised more effectively in people’s jobs and lives, Faulkner, Breen, Prendergast and Carr (2022, this publication) compare the problem-solving and procedural skills of adults in mathematics education in Ireland. They find that adults in mathematics education in Ireland have significantly weaker problem-solving skills in mathematics when compared

with procedural skills. This lack of problem-solving skills aligns with findings amongst third level students in schools, however the same investment/interest in improving the provision of mathematics education for adult learners is not present. They further argue that these findings are misaligned with one of the key recommendations of the 'Adult numeracy: Assessment and development' policy to "invest in the development of national capacities to measure and improve adult numeracy" (Gal & UNESCO, 2020, p.3).

This lack of investment in appropriate teacher training for adult numeracy educators is exacerbated for those who are asked to take on the responsibility of teaching adults' numeracy without the requisite skills and knowledge, as research shows by Prendergast, O'Meara, O'Sullivan, and Faulkner (2022, this publication). Their research highlights an unmet demand for professional development in adult numeracy education, with many numeracy practitioners looking for opportunities to develop their practice. In response to this need this research group aims to establish a series of online 'Numeracy-Meets' for adult numeracy practitioners. They outline a new model of support that focuses on topics such as Family Numeracy and Financial Literacy rather than teaching traditional topics such as fractions in isolation. Through the establishment of an informal community of practice they aim to meet the professional development needs of practitioners. It is early days for this project which, if successful, hopes to expand its reach both nationally and internationally.

Forster, Faulkner and Prendergast (2022, this publication) have also undertaken further study into the relationship between psychosocial factors, demographics, the level of mathematics studied and progression for Access students. Their findings show that students studying foundation mathematics had significantly higher scores for amotivation and neuroticism. While those who chose to study advanced mathematics, students had ranked more highly for general self-efficacy (GSE), belief about mathematics ability (BMA) and intrinsic motivation to know. Additionally, female students were significantly less likely to study advanced mathematics than males. Non-Irish nationals studying advanced mathematics were significantly less likely to progress to higher education than their peers. All these findings need to be further explored in relation to motivation and reasons for study in relation to the notion of success. The research recommends teachers engaging students in enactive self-mastery but also the importance of role-modelling and verbal persuasion in encouraging progression to higher education and higher-level mathematics studies.

Stacey (2022, this publication) in her doctoral research seeks to explore possible changing perceptions in relation to adults' motivations, mathematics anxieties around mathematics and confidence while learning mathematics. Working with adult numeracy learners (19+) returning to the further education sector in the UK to study GCSE Mathematics. Although still in the pilot phase, her paper also raises several key issues in relation to continuing professional development for numeracy teachers. She highlights the very under-researched group of adult learners (+19), as most research on learners' perceptions of mathematics has been conducted with school aged, 16–18-year-olds in further and higher education students. She also raises the issue of variation in professional development for teachers on offer, highlighting a lack of understanding of how different countries and universities organise both full and part time doctoral education as part of their professional development programmes.

Forwarding the field

The papers in this workshop show research into the field of adult numeracy has a huge amount to offer the teaching of mathematics in schools, as it reflects the lived experience of numbers recognising its complexities. Yet as Diez-Palomar and Hoogland (2022, this publication) found, numeracy has very little visibility in the research world which means it is out of the reach of policy makers. This is undoubtedly a result of Coben's (1994) ideas of differences in cultures in the research world on school mathematics education and the practitioners' experience of teaching adults. But it can also be seen as developing from a historical deficit of political interest and funding in adult education outside university level. For example, in the UK until PIAAC identified national skills discrepancies there was little interest or investment in developing the numeracy and literacy skills of adults. Researchers in the field of adult numeracy need to explore ways to promote the wealth of research that exists in this area, but also the significant gaps. The pandemic and the greater use of technology also offer more opportunities for practitioners and researchers to join, network, and promote the benefits of adult numeracy.

The papers outline a strong case for interest and investment in adults' numeracy education, when considering the impact on people's lives and the potential empowering and transforming nature of mathematics. However, the research into the resultant effects of an over skilled or under skilled workforce on global economic inefficiencies, job dissatisfaction, high turnover costs and loss of productivity are clearly made. Yet papers in this working group provide clear evidence of underinvestment in adult education with the serious consequences it has for learners at all levels.

Conclusion

Employers, politicians, and educators want people to have a higher quality of numerate and mathematical behaviour to handle numeracy situations effectively in their daily lives, but typically use standardized school mathematics tests to assess these qualities. Unfortunately, most of these tests are not designed to capture the multifaceted nature of numerate behaviour and therefore provide an image that is too narrow to reflect such behaviour. The research field of adult numeracy and mathematics education recognises the complexity of numerate and mathematical behaviour and offers insights into possible approaches that can be used within mathematics education, casting a broader light on the intricacies of mathematical and numerate behaviour in the context of everyday life.

The notion that technology is leading to a society becoming increasingly 'mathematised' should be considered more seriously in research on mathematics education, for instance by using global research databases, such as PIAAC (OECD, 2019), that enables us to compare and analyse how different societies and countries deal with this issue in their educational policies and practices.

Research in this working group shows the importance of adult numeracy research in relation to life opportunities and inclusive societies, yet point to a lack of visibility in academic research with the consequent lack of effect in learning from work undertaken into adult numeracy research and practice. Understandably policy makers are currently focused on the long-term effects of the Covid -19 pandemic on school children and their learning. Yet these few texts indicate a real need for resources to be invested beyond schools to respond to the demands on adults' numeracy requirements to engage fully in life chances relating to health, finances, employability and through civic society.

References

- Coben, D. (1994). Preface and content. *Proceedings of the International Conference of Adults Learning Mathematics (ALM)* 1, 11-17.
- Council of Europe (1990) Education in Prison: *Recommendation No. R (89) 12 adopted by the Committee of Ministers of the Council of Europe on 13 October 1989*. Strasbourg: Council of Europe.
- Gal, I., Grotlüschen, A., Tout, D., & Kaiser, G. (2020). Numeracy, adult education, and vulnerable adults: A critical view of a neglected field. *ZDM*, 52(3), 377-394. <https://doi.org/10.1007/s11858-020-01155-9>
- Gal, I., & UNESCO Institute for Lifelong Learning (UIL). (2020). *Adult numeracy: Assessment and development*. <https://unesdoc.unesco.org/ark:/48223/pf0000375130>
- Hodgen, Taylor, B., Jacques, L., Tereshchenko, A., Kwok, R., & Cockerill, M. (2020). *Remote mathematics teaching during COVID-19: intentions, practices and equity*. UCL Institute of Education.
- Hoogland, K.; Kelly, B., & Díez-Palomar, J. (2019). Introduction to TWG07 Adult Mathematics Education. In U. T. Jankvist, M. van den Heuvel-Panhuizen, & M. Veldhuis (Eds.), *Proceedings of the Eleventh Congress of the European Society for Research in Mathematics Education* (pp. 1293-1300). Utrecht, the Netherlands: Freudenthal Group & Freudenthal Institute, Utrecht University and ERME.
- Kuhn, T. S., Conant, J., & Haugeland, J. (2000). *The road since structure: Philosophical essays, 1970-1993, with an autobiographical interview*. University of Chicago Press. p. 98-101
- Lerman. S. (2000) The Social Turn in Mathematics Education Research, in: *Boaler, J. (ed.) Multiple Perspectives on Mathematics Teaching and Learning*. Westpoint, USA: Ablex Publishing.
- OECD (2013). *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*. Paris, France: OECD Publishing. <https://doi.org/10.1787/9789264204256-en>
- OECD (2019), Skills Matter: Additional Results from the Survey of Adult Skills, *OECD Skills Studies*, OECD Publishing, Paris, <https://doi.org/10.1787/1f029d8f-en>.
- Spiegelhalter, D. (2017), Trust in numbers. *J. R. Stat. Soc. A*, 180: 948-965. <https://doi-org.libproxy.ucl.ac.uk/10.1111/rssa.12302>
- Withnall (1994) Towards a definition of Numeracy. *Proceedings of the International Conference of Adults Learning Mathematics (ALM)* 1, 11-17.
- Yasukawa, K., Rogers, A., Jackson, K., & Street, B. V. (2018). *Numeracy as social practice: global and local perspectives*. Routledge. <https://doi.org/10.4324/9781315269474>