Numeracy and Vulnerability

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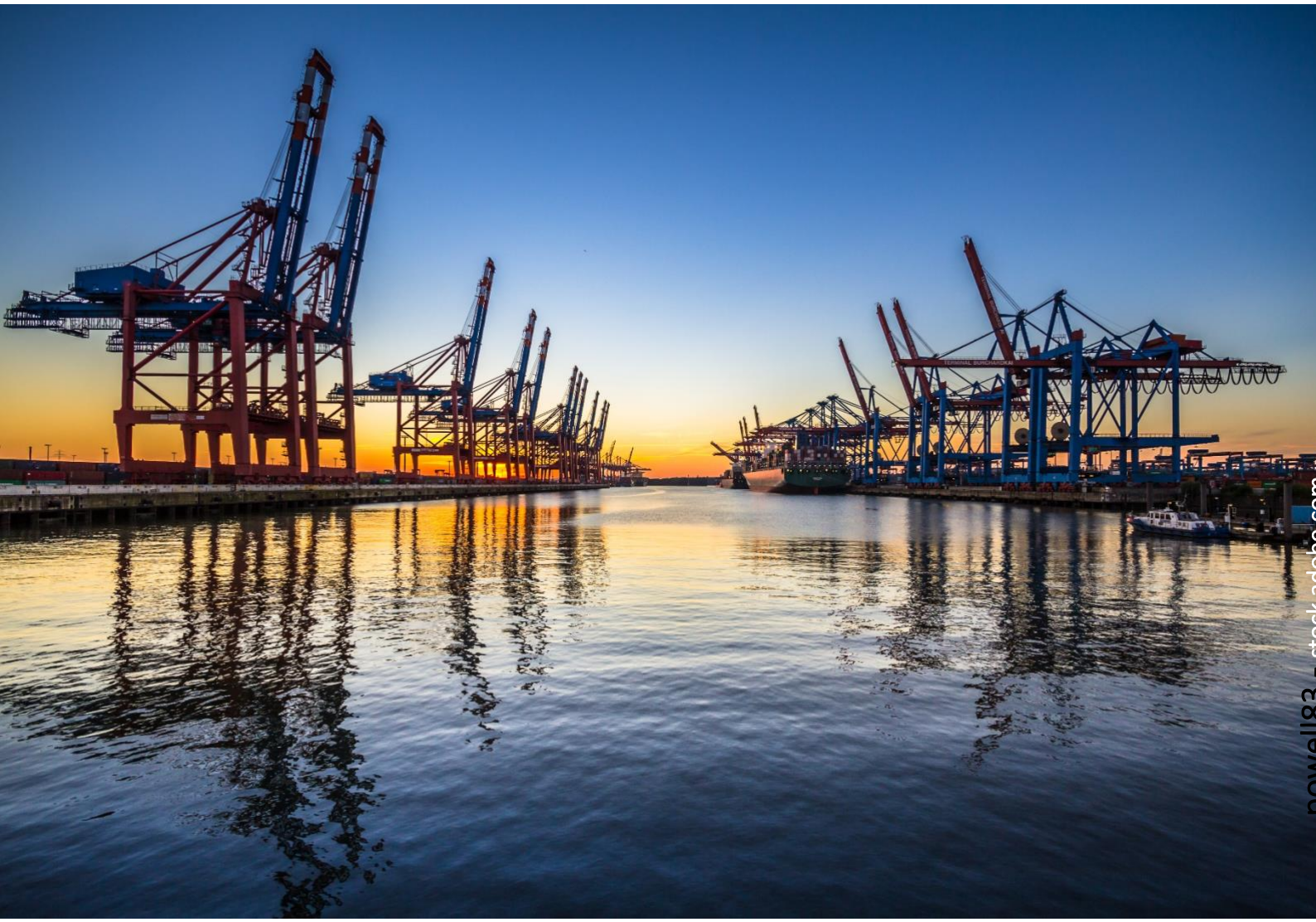

Numeracy and Vulnerability

Proceedings of the 28th International Conference
of Adults Learning Maths – A Research Forum (ALM)

Hosted by the Institute of Lifelong Learning,
Faculty of Education, University of Hamburg

July 5th – July 7th 2020

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About ALM

Adults Learning Mathematics – A Research Forum (ALM) was formally established in July, 1994 as an international research forum with the following aim:

To promote the learning of mathematics by adults through an international forum that brings together those engaged and interested in research and development in the field of mathematics learning and teaching.

Charitable Status

ALM is a Registered Charity (1079462) and a Company Limited by Guarantee (Company Number: 3901346). The company address is: 26 Tennyson Road, London NW6 7SA,UK.

Aims of ALM

ALM's aims are to promote the advancement of education by supporting the establishment and development of an international research forum for adult mathematics and numeracy by:

Encouraging research into adults learning mathematics at all levels and disseminating the results of this research for the public benefit.

Promoting and sharing knowledge, awareness and understanding of adults learning mathematics at all levels, to encourage the development of the teaching of mathematics to adults at all levels for the public benefit.

ALM's vision is to be a catalyst for the development and dissemination of theory, research and best practices in the learning of mathematics by adults, and to provide an international identity for the profession through an international conference that helps to promote and share knowledge of adults' mathematics teaching and learning for the public benefit.

ALM Activities

ALM members work in a variety of educational settings, as practitioners and researchers, to improve the teaching and learning of mathematics at all levels. ALM holds an international conference each year at which members and delegates share their work and meet each other in an academic but informal environment. The conference enables an international network which reflects on practice and research, fosters links between teachers, and encourages good practice in curriculum design and delivery using teaching and learning strategies from all over the world. ALM does not foster one particular theoretical framework, but encourages discussion on research methods and findings from multiple frameworks. ALM produces and disseminates Conference Proceedings and a multi-series online Adults Learning Mathematics–International Journal (ALM-IJ).

ALM holds an international conference each year at which members and delegates share their work, meet each other, and network. ALM produces and disseminates Conference Proceedings and a multi-series online Adults Learning Mathematics – International Journal (ALM-IJ).

ALM website

On the ALM website http://www.alm-online.net, you will also find pages of interest for teachers, experienced researchers, new researchers and graduate students, and policymakers.

Teachers: The work of members includes many ideas for the development and advancement of practice, which is documented in the Proceedings of ALM conferences and in other ALM publications.

Experienced Researchers: The organization brings together international academics, who promote the sharing of ideas, publications, and dissemination of knowledge via the conference and academic refereed journal.

New Researchers and Ph.D. Students: ALM annual conferences and other events allow a friendly and interactive environment of exchange between practitioners and researchers to examine ideas, develop work, and advance the field of mathematics teaching and learning.

Policymakers: The work of the individuals in the organization helps to shape policies in various countries around the world.

ALM Members

ALM Members live and work all over the world. See the ALM members' page at www.almonline.net for more information on regional activities and representatives, and for information on contacting your regional representative. How to become a member: Anyone who is interested in joining ALM should contact the membership secretary. Contact details are on the ALM website: www.alm-online.net.

Membership fees for 2021

	Sterling	Euro	US Dollar
Individual	20	24	32
Institution	40	48	64
Student/unwaged	4	6	7
Low waged	Contribute between full and unwaged		

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… Kristin Skowranek and Sylvia Werner for taking on the challenge of organising a digital conference in times of uncertainty and in unpredictable circumstances. From the start, you were involved in every step of the planning and organising; you kept your head and moods up when we had to switch from a real-life conference in Hamburg to the digital conference, you enthusiastically took on every new challenge and helped us all to navigate through the digital and non-digital challenges of the conference.

Conference host

University of Hamburg

The University of Hamburg was founded in 1919 by the city council and has since grown to become the largest institution for research and education in northern Germany. It is one of Germany's largest universities and part of the Excellence Strategy of the Federal and State Governments.

The Institute for Adult Education/Lifelong Learning, headed by Anke Grotlüschen has been researching literacy, numeracy and basic adult education. In 2012 and 2018 they conducted a national survey on low literacy in Germany (LEO surveys) and from 2017 to 2021 they were part of the Hamburg Numeracy Project.

The Hamburg Numeracy Project

The Hamburg Numeracy Project (in German: Alltagsmathematik als Teil der Grundbildung Erwachsener) was a joint research project on the relevance and implications of (low) numerate competencies of adults in Germany. It aimed to broaden the understanding of numeracy to include not only school mathematics but also everyday mathematics. In the course of a general paradigm shift in Germany from functional literacy to a more complex understanding of basic education, numeracy skills were still widely under-researched when the Hamburg Numeracy Project started.

In six subprojects, multiple questions and topics were researched within the framework of the overall joint project:

1) Which results can be aggregated from the internationally comparative International Adult Literacy Survey (IALS, 1995) and Programme for the International Assessment of Adult Literacy (PIAAC, 2012) with regard to everyday mathematical practices? (Anke Grotlüschen, Luise Krejcik, Alina Redmer; University of Hamburg)

2) What is numeracy as social practice and what significance does it have in the social context? Which numeracy practices do the war and post-war generation have? Which meanings are ascribed to numeracy practices in these generations? Do they maintain or reinforce competence? (Christine Zeuner, Antje Pabst, Melanie Benz-Gydat, Helmut-Schmidt-University/University of the Federal Armed Forces in Germany)

3) What would a diagnostic instrument for competencies look like that can be used for the quality assurance of adult basic education courses – focussed on cooperating North and West African countries? (Rakhat Zholdoshalieva, Huacong Liu; UNESCO-Institute for Lifelong Learning)

4)To what extent do every day mathematical practices be identified as a mechanism in individual debtor careers? Can suitable practices be mediated through counselling to support over-indebted people and to enable them to regain social participation and financial stability? (Harald Ansen, Katharina Angermeier; University of Applied Sciences Hamburg)

5) In which situations and in what ways are everyday mathematical practices used by people with learning difficulties? What types of practices can be systematised? (Silke Schreiber-Barsch, University of Hamburg/ now: University Duisburg/Essen; Wiebke Curdt; University of Hamburg)

6) What are the findings concerning everyday mathematical competences and numeracy practices of refugees from countries of origin and host countries? What is known about their mathematics-specific learning approaches and the underlying didactic approaches? (Gabriele Kaiser, Maike Lüssenhop)

About ALM 28

The ALM 28 was – being held in July 2021 and therefore in times of the Covid pandemic – a digital conference hosted by the Institute for Lifelong Learning of the Hamburg University. The conference was set at the end of an almost four-year long collaborative research project, the 'Hamburg Numeracy Project'.

The conference was spread over three days, and attended by approximately 60 researchers, practitioners and policymakers from all around the world.

The guiding question of the conference was the relationship between numeracy and vulnerability (on individual as well as societal levels). Five keynote speakers and 30 presenters spoke at the conference and shared their knowledge, experience and research on this relationship from a wide variety of perspectives.

All participants were welcomed to the conference on Monday morning by the ALM chair Beth Kelly and host Anke Grotlüschen. Afterwards, Lisanne Heilmann gave a brief introduction into the platforms and highlights of the conference as well as ways to participate and interact during the digital conference.

Anke Grotlüschen (professor of lifelong learning at the University of Hamburg in Germany) gave the first keynote titled 'Vulnerability in Adult Life – and how it affects Numeracy Practices'. She introduced general, theoretical and practical concepts of vulnerability in modern societies. The way in which specific numeracy skills can reduce or increase the risk of vulnerability for people or populations is a common research theme of the Hamburg Numeracy Project and several exemplary results of the partially completed project were presented.

Closing the first day of the conference, Gelsa Knijnik (professor at the Universidade do Vale do Rio dos Sinos in Brazil) gave a presentation on 'Numeracy, vulnerability, ethics and social justice'. She retraced the development of the Brazilian land movements and their specific vulnerable circumstances and demonstrated the relevance of numeracy skills to their commitment to achieve more social justice.

Digitalization and automation, especially in terms of labour allocation, have brought and will increasingly bring new challenges to achieving social equality and reducing vulnerability in our societies. Suzanne Symthe (professor at the Simon Frazer University in Burnaby, Canada) presented her findings and showed that the automation of, for example, job applications ask applicants not only to have new technical skills but also to understand the complex workings of social platforms and algorithms (title: the new literacies of automation: Justice in the digital era).

José Julián Cao-Alvira (professor at the City University of New York, USA) shared his work on 'Financial numeracy and vulnerability'. He demonstrated the relevance that not only numeracy skills but socio-demographic factors like the gender of the head of household show a strong relation to a person's or household's debt management and indebtedness.

Looking at a global context and climate, we had a discussion and a workshop with Chris Budd (professor at the University of Bath, Gresham College, UK) on 'Climate change in the

mathematics and numeracy classroom'. The workshop was chaired by Beth Kelly (ALM chairperson, University College London, Institute of Education, UK).

Closing the conference and pulling the focus back into the current Covid pandemic, Kevin McConway (professor at the Open University, UK) shared his thoughts and experiences on the relation of 'Covid-19 and numeracy challenges'. The pandemic has been an object of mathematical (especially statistical) learning for individuals. It has also demonstrated the difficulties of public discourse and public communication of relevant health-related statistics.

The plenary speakers were joint by 13 presentations and workshops that focussed on a broad variety of numeracy-related vulnerabilities. The whole conference was accompanied by several platforms and spaces for participants to connect in a digital form. One of the off-topic highlights and moment of connectedness was dancing to the 'Jerusalema' together.

We thank everybody that made the digital conference possible and made it come alive, filled the discussions and talks with their thoughts, experiences, theories, and goals. We wish everybody strength and health in these troubling times and hope that one day we might be able to really invite everybody to Hamburg.

Theme of the conference

At the 28th ALM conference, we choose 'Numeracy and Vulnerability' as the overall theme. Research on numeracy often takes the form of large-scale quantitative studies, a prominent example being the PIAAC study (OECD, 2019). Numeracy is understood here as a measurable construct, and numerical competence can be related to various socio-demographic and socio-economic factors. Numeracy as a social practice, on the other hand (Yasukawa et al., 2018) is more the subject of smaller qualitative studies. Regardless of the approach taken, numeracy can be related to exclusion from participation. Low numerical skills and the infrequent practice of numerical practices can, it is assumed, lead to increased vulnerability (Gal et al. 2020) to social disadvantage or exclusion among individuals and social groups.

The ALM Conference in Hamburg in 2021 will focus on this connection between numeracy and vulnerability. We are looking forward to contributions that address this issue, for example by exploring the links between numerical competences and practices on the one hand and possible disadvantages in the context of finance and consumption, work and family, health (e.g., context Covid 19) or digitisation on the other. Also of interest are contributions on educational needs and educational policy frameworks that become visible in the context of numeracy and vulnerability.

References

Gal, Iddo; Grotlüschen, Anke; Tout, Dave; Kaiser, Gabriele (2020): Numeracy, adult education, and vulnerable adults: a critical view of a neglected field. In: ZDM Mathematics Education, 1–18. DOI: 10.1007/s11858-020-01155-9.

OECD (2019): Skills Matter. Additional Results from the Survey of Adult Skills. Paris: OECD Publishing (OECD skills studies).

Yasukawa, Keiko; Rogers, Alan; Jackson, Kara; Street, Brian (Hg.) (2018): Numeracy as Social Practice. Global and Local Perspectives. New York.

Plenary Speakers-Presentations

Abstracts in order of appearance.

All recordings of the keynote presentations can be found on the ALM YouTube channel: https://www.youtube.com/playlist?list=PLw1HEUYFGV1mc-Zz4GoZI8ZO38wX95V66

Vulnerability in Adult Life – and how it affects Numeracy Practices

Anke Grotlüschen

University of Hamburg

Anke Grotlüschen is Professor of Lifelong Learning at the Faculty of Education at the University of Hamburg. Her work focuses on digital media and learning theory, adult education target group and interest research, literacy and basic education research, citizenship and cultural adult education. Anke is responsible for the German National Level One Survey (LEO) and is the speaker of the co-operative research project on Adult Numeracy (Hamburg Numeracy Project) with the UNESCO Institute for Livelong Learning, the University of the Armed Forces and the University of Applied Sciences.

In this keynote, Anke Grotlüschen introduces the concepts and the relation of vulnerability and numeracy practices: We understand humans in societies as mutually dependent and therefore as vulnerable, and we see vulnerability as a genuine aspect of life. Vulnerability is necessary to open up for deep interpersonal relations, for being involved or moved and it is definitely a prerequisite for falling in love. Vulnerability means, we care – maybe for our loved ones, maybe about our jobs. Others can hurt us, but we trust them that they won't actually do it. This is how many wealthy and/or privileged adults in industrialized societies live. But some parts of our societies are not only vulnerable (i.e., in risk of) but they actually do get hurt by other individuals, their societies structures or institutions. They get inadequately paid or exploiting work contracts. We use the term vulnerability to specifically look into the various risks of being hurt, marginalized or excluded for different groups. We match research on numeracy skills and numeracy practices with this notion of vulnerability. Numeracy skills and practices decline over time and in higher age, they are socially gendered in their nature and distribution and cannot be discussed without reproduces stereotypes. Training does not necessarily address the most needy, and numeracy training needs to be understood much broader and more critical than as mere basic calculation.

Numeracy, vulnerability, ethics and social justice

Gelsa Knijnik

Universidade do Vale do Rio dos Sinos

Gelsa Knijnik is a retired professor of the Graduate Programme on Education at the Universidade do Vale do Rio dos Sinos, Brazil. She conducts research in the field of Mathematics Education from a socio-cultural perspective. Her academic trajectory is linked to ethnomathematical studies. She is the Chair of TSG # 52 Ethnomathematics at ICME-14, which will take place in Shanghai, this July.

Based on my work with the Brazilian Landless Movement, in my talk I will highlight the role numeracy can take in vulnerable social groups to contribute to overcome their precarious living situation. In this perspective, we can consider numeracy an (even if very small but still valuable) element of the complex processes to search for social justice. Nevertheless, to fulfil its role ethics must be central to our numeracy practices and studies. In a broader sense, in contemporaneity, more than ever, I would argue that ethics must be central to our everyday life if what is at stake is to have a more just and inclusive society.

The new literacies of automation: Justice in the digital ear

Suzanne Smythe

Simon Frazer University, Burnaby

Suzanne Smythe is Associate Professor of Adult Literacy and Adult Education in the Faculty of Education and Simon Fraser University in British Columbia, Canada. Her current research program is concerned with digital literacy pedagogies, digital justice, and equitable access to new technologies for youth and adults. Recent examples of this work can be found in the *International Review of Education (2021)* with Amea Wilbur and Emily Hunter, and in *Studies in the Education of Adults (2020)* with Klaus Buddeberg and Anke Grotlüschen. Dr. Smythe is the principal investigator of a new research grant awarded by the Canadian *Social Sciences and Humanities Research Council* that will explore with community organizations adults' experiences of digital and algorithmic inequalities, and possibilities for more just digital worlds and literacies.

The presentation describes examples of encounters between people, technologies, and algorithms that are drawn from research in community-based settings in North America, with particular attention to the phenomena of online job applications and e-recruitment platforms. Nonhuman decision-making is increasingly common in North American job search and other services, and becoming so in other jurisdictions. This is raising important questions about the role of automation and algorithms in the production of precarious labour, and in the very meanings of literacy in a world that must contend with the pedagogies and politics of the nonhuman. What do these new literacies of automation mean for adult education research and practice, particularly in this pandemic moment? How might adult educators and researchers locate themselves within movements for literacy and justice in the digital era?

Financial numeracy and vulnerability

José Julián Cao-Alvira

Lehman College of The City University of New York

José Julián Cao-Alvira is Professor of Finance and Economics for Lehman College of The City University of New York. He obtained a Ph.D. in Economics from Cornell University, and holds professional designations as a Certified Financial Planner (CFP) and Financial Risk Manager (FRM). His fields of research include microcredit banking, financial literacy, investment analysis, international trade and competitiveness. José Julián chairs the Research Division at PRIME Business School of the Universidad Sergio Arboleda in Bogotá, Colombia and actively serves as a Visiting Researcher at international academic institutions, being the Center for North and South Economic Research of the University of Sassari in Sardinia, Italy the most recent of these. José Julián's most recent work, published in the Review of Development Economics, attempts to find the linkages that exist between financial numeracy and the indebtedness and wealth of households in Bogotá, the capital of Colombia.

In this keynote José Julián Cao-Alvira did speak about these linkages of financial literacy with indebtedness and wealth accumulation of households in Bogotá. The main question is about the relationship between the financial literacy and money management skills of the heads of households with the way households use and manage debt, the cost of debt servicing and several wealth indicators. Numeracy skills are found to have a positive correlation with the decision to use debt and have a mortgage and with the total number of lending sources, debt-to-income, and net worth. The speech uncovers important debt and wealth accumulation conducts closely tied to the city's economic stratification and the gender of the head of household, thus discussing questions of unequal degrees of vulnerability. A number of public policy implications are derived from the results of the analysis.

Climate change in the mathematics and numeracy classroom

Chris Budd[1] (Discussion) & Beth Kelly[2] (chair, workshop)

[1]University of Bath,
Gresham College

[2]ALM chair
University College London
Institute of Education

Chris Budd OBE is Professor of Applied Mathematics and Director of the Centre of Nonlinear Mechanics at the University of Bath, UK. He has a long history of engagement in the public understanding of science and mathematics through institutions such as the UK Royal Institution and the Institute of Mathematics and its Applications.

As a graduate of Oxford and Cambridge, Professor Budd has held the position of Professor of Applied Mathematics at the University of Bath for over twenty years. His other current positions include Chair of Mathematics at the Royal Institution at Great Britain since 2000, and Professor of the Public Understanding of Mathematics at the ICMS, Edinburgh, since 2015.

Professor Budd's broad research interests involve interdisciplinary industrial and applied mathematics. He has worked with the UK Met Office for over ten years and his algorithms are now incorporated into national operational weather forecasting. He is currently carrying out research on climate modelling using modern mathematical and computational methods and is actively involved in a number of international climate modelling networks, including CliMathNet, which he co-directs, and the Mathematics of Planet Earth programme. He also collaborates with the energy industry, the aerospace industry, the telecommunications industry and the food industry.

Discussion Title: Climate change in the mathematics and numeracy classroom

In a well-received webinar Professor Chris Budd describes how complex climate models work and the assumptions that go into them. He discusses the reliability of predictions of climate change, and shows how mathematics can give us insights into both past and future.

We are delighted that Professor Budd has agreed to join us for this discussion group and we will take his webinar available at https://www.gresham.ac.uk/lectures-and-events/mathematics-climate-changeas a starting point for our discussion. When we can consider:

How mathematics lessons can be used to contribute to better understanding of the models involved in climate change? How numeracy lessons can be used to critically look at media coverage of climate change? We will then use the discussion group to explore further three aspects of the relationship between mathematics and climate change:

- exploring ideas highlighted in Professor Budd's seminar
- sharing resource ideas and approaches to teaching climate change through mathematics and numeracy
- possible ways that participants could develop resources or projects to support the better understanding of climate change through mathematics.

We look forward to an interesting debate and hope that participants can bring contributions and insights of their own to the discussion.

Covid-19 and numeracy challenges

Kevin McConway

Open University

Kevin McConway is Emeritus Professor of Applied Statistics at the Open University in the UK, where he taught statistics to adult students in a wide range of disciplines. He has researched collaboratively across natural and social science. Kevin McConway has developed a strong interest and involvement in statistics in the media. In particular, he was as adviser for eleven years and an occasional contributor to the BBC radio programme 'More or Less', which aims to support the public understanding of data and research, and he has worked with and helped train journalists in understanding and communicating statistics, often through the UK's Science Media Centre where he is a member of the advisory committee.

Kevin McConway will be discussing numeracy concerns that have come to the fore because of the pandemic. Some of the concerns, for example on understanding of risk, on dealing with numerical uncertainty, and on exponential growth have always been around, but have increased in salience and importance. Others, for example on the role of mathematical models in epidemiology, and on error types and rates in diagnostic tests, have become matters of public importance. Though mathematicians, statisticians, epidemiologists, and educators have played a role in addressing these concerns, most of the work during this fast-moving crisis has been mediated through traditional media channels and social media. Those of us working on developing public understanding of statistics and mathematics therefore need to develop effective ways of engaging with these media. That's not a simple matter, given the multiple competing interests and the vast number of actors involved. Kevin will argue that there have been some successes, some failures, and perhaps some pointers towards being more effective in the future.

Parallel Sessions
–
Presentations

We have included long abstracts and articles from the presenters at the ALM 28 Conference in alphabetical order.

Note: Papers for these Proceedings are based on the long abstracts prepared by presenters for the Conference. They have been updated and edited and, in some cases, longer versions have been submitted. It is a recent decision of the Trustees of ALM to use revised versions of the long abstracts, which are lightly edited, but not peer reviewed, as papers for the proceedings. Conference presenters are still invited to submit longer articles for review based on conference presentations to the ALM International Journal editor-ij@alm-online.net.

ALM Mathematics in Prison (MiP)

Catherine Byrne; Tatiana Harrison; Reggie Temple & Joan O'Hagan

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Abstract

Mathematics in Prison (MiP) topic group is a new initiative from Adults Learning Mathematics (ALM) and aims to link practitioners and researchers interested in mathematics education in prisons and the secure estate. The topic group grew from a seminar that was part of the ALM virtual seminar series. Interest was expressed by those attending to develop an international group focusing on the challenges and opportunities afforded to adults learning mathematics in this unique and under researched context.

Introduction

We will base the ALM 28 workshop on the MiP topic group. In this workshop we will offer an informal session to facilitate the sharing of perspectives and experiences of practitioners in this field, to share research that has already been published and give an overview of our progress to date.

The topic group offers a forum to share good practice, discuss methodologies and explore the challenges practitioners and researchers face working in the secure estate. We will encourage informal conversations between practitioners and researchers to identify common themes and investigate ways that the MiP topic group might support mathematics education in this context in the future. We study experiences, literature, and best practices on topics such as teaching fractions (Ginsburg 2019), assessment and technology enhanced learning.

The Prison Education Context

In our meetings we found that mathematics education in different countries varies in language, culture and statutory basis. Yet we share many similarities, as students who have found themselves detained in prison, choose to learn mathematics often after a long break away from formal education.

Overview of the Mathematics in Prison Topic Group

As stated, the MiP group grew out of a discussion that continued after the fourth virtual ALM seminar "Adults Mathematics in Prison Education" lead by Linda Ahl who discussed her experiences of teaching in the Swedish Prison system. After the discussion we advertised the first topic group meeting through the ALM mailing list. The first gathering included participants from Sweden, UK, Canada, USA, Ireland, Northern Ireland. We reflected on the best way to communicate with those in the group during the meeting, and we decided to use Google Jamboard. This interactive smartboard enables teachers and students to collaborate on a virtual whiteboard, to allow to brainstorm ideas and create sketches (Virto et al 2020). We set up a link

to Google Jamboard with questions composed by the group leaders ahead of the meeting. At the meeting, we invited participants to answer the questions and contribute to discussions suggested on the Jamboard.

The drawback of Jamboard is that anyone can remove and add material. As participants are working in prisons, there is awareness of the need for privacy and security. The decision was made to share the link during the meeting so people could add ideas and then we closed the link so no one else could change or share it. Finally, we shared a PDF of the meeting and brainstorming with the participants. A summary of the discussion was shared with the ALM trustees.

The content indicated educators were working with a wide range of age groups, in different departmental systems and with varied resources. The use of IT within the secure systems was diverse and this is one area that could be an important source sharing ideas and approaches to developing mathematics.

One of the challenges in teaching mathematics is this sector is how to be authentic in the contexts chosen. However, for privacy reasons, we did not share the information widely afterwards, although a summary of themes was reported to the ALM trustees. Included in the data collected were their names, types of workplaces, locations, students' profile, ethical dilemmas, observations and questions.

Rationale and Statutory basis for teaching and researching mathematics in prisons.

Education in prisons is under theorised despite its wide existence across the world (Szifris 2018). Mathematics education in prison is a more limited field of research still but has been added to recently by Ahl (2020) who argues for more research into this specialist field. Anecdotal evidence from practitioners shows that prisoners and people in detention have unmet needs in mathematics and numeracy.

Mathematics education in prison is a basic life skill (Council of Europe 1990). Yet it varies considerably across countries and within national systems. Levels of mathematics education have been investigated in prisons in the UK (Creese 2016) and the USA (Rampey et al 2016). In Ireland priority is given to those in prison with basic educational needs, including numeracy and literacy (Irish Prison Service 2019). In the UK, Coates (2016) advocates for development of basic skills in mathematics, as well as English, and Information and Communications Technology (ICT).

Future ideas for activities in the MiP Topic Group

We will decide in the future what approach the group will take as we hope to generate interest by presenting at ALM 28. We plan to gather more reflections on experiences from within mathematics classrooms in this context. This may include instructional strategies, teachers' professional development needs and experiences. We plan to collaborate on the instructional strategies and materials and their impact in classrooms that teachers share with us. Assessment in adult education is a core issue and mathematics assessment in prisons is an important concern as mathematics is a gateway subject to further education.

Some sources for discussion in this group include an educator might develop a curriculum or resources for a specific group of adult learners, in this setting. Another option may be to pose a problem for the group on a specific problem or project the group could reflect on why the students struggle with this topic and offer strategies on how to deal with it. Another idea could be to reflect on the impact and relevance for the practitioner of an article or book in ALM or other sources. This could lead to activities and experiments in-class in the future which may confirm or challenge the original findings.

Conclusion

We expect the workshop to stimulate further interest after ALM 28 and expect that the journal paper will add to the limited research in this field.

We will share the learning from the topic group so far in the workshop. We also hope that we will develop a dialogue on continuing professional development within the prison sector across national boundaries.

The journal paper will be based on the ALM guidelines for practitioner papers (Ginsburg 2019). This may take the form of an article about practice, individual practitioners' action research or teaching experiments, and may involve learners, following all appropriate ethical guidelines.

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Experiences of personal and policy 'failure' for mathematics students in post-16 vocational education

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Developing mathematics skills is an educational priority for many countries due to the societal economic returns but the implications for educational and career progression, and, therefore future prosperity are also key (Dolton & Vignale's, 2002). In countries such as England, where international comparisons are disappointing (e.g., Kankaraš, et al., 2016) and national surveys indicate low levels of mathematics and numeracy skills, mathematics education is high on the policy agenda. In this session, we consider how young people who achieve low grades in high-stakes national examinations at age 16 are impacted by what is commonly described as 'failure'. We also explore how a policy intended to improve mathematics skills has varied effects on progression, attitudes and engagement.

In England, students take General Certificate in Secondary Education (GCSE) qualifications in a range of subjects at age 16. Since 2014, those who fail to reach a specified minimum standard in GCSE mathematics (grade 4) by age 16 have been required to continue studying the subject in upper secondary post-16 education, with the aim of retaking the examination and making the grade. The majority of those required to retake mathematics under this policy follow vocational pathways post-16. Those with lowest GCSE grades at age 16 (grades 1 and 2) may take what the government describes as 'steppingstone' Functional Skills qualification first, which focuses on skills development and application in realistic contexts. There has however been an increasing trend away from such qualifications

Drawing on analyses from the Mathematics in Further Education Colleges project (MiFEC), we begin by examining what qualifications and skills these students gain as a result of this compulsory retake policy. This is followed by considering how students respond to their failure to reach the accepted GCSE grade at age 16 years, based on data from 62 focus groups carried out during the MiFEC project. Finally, we discuss the positive and negative outcomes for students of the policy, with particular attention to the 'exchange value' of the academic GCSE qualification and the 'use value' of a functional skills curriculum (Williams, 2012).

The 'pass' rate for post-16 students retaking GCSE mathematics in England is low; less than a quarter achieve the required grade by age 18. Measures of maths progress are similarly disappointing and few of those more than one grade below the pass level make any measurable improvement in upper secondary education (Noyes, Dalby & Smith, 2021). In terms of a GCSE examination outcome, the policy leaves many students in no better position than they were at age 16.

The MiFEC evidence highlights the acute sense of failure that many students experience at age 16 when their GCSE result falls below the grade 4 standard. This often leads to decreased motivation, self-efficacy and engagement with mathematics. As a result, many students experience further failure as they make repeated unsuccessful attempts to pass the GCSE

examination (i.e., at grade 4) post-16. These experiences tend to reinforce negative dispositions and increase maths anxiety. The minority of students who actually make the grade welcome this as an end to their mathematics learning. For the majority, grade 4 remains a seemingly insurmountable challenge. Negative dispositions towards continued mathematics learning are prevalent in both groups, with most of these young adults remaining relatively disadvantaged by their mathematical attainment, despite a policy intended to improve their life chances.

The aforementioned Functional Skills qualification offers a different kind of mathematical learning experience, focused on the development of skills in using and applying mathematics. This option has decreased in popularity as a direct consequence of the ways in which national accountability measures work, effectively steering post-16 institutions towards offering GCSE in preference to Functional Skills. The trend away from the application of skills in context to traditional academic qualifications does little to bridge the gap between classroom mathematics and everyday practices (Nunes et al., 1993; Yasukawa et al., 2018).

In England, GCSE Mathematics is a key gate keeper, controlling who can and cannot access various careers, higher-level vocational courses and Higher Education. The qualification has a high 'exchange value' and students who achieve the recognised minimum grade are at an advantage in a competitive employment market. It would seem, therefore, that a policy that offers all students the chance to achieve this outcome is a good one. In reality though, only a small minority of post-16 students make the grade. The collateral damage is increasingly negative dispositions to mathematics and reduced opportunities for students to develop skills in using and applying mathematics in life contexts. We conclude that many of these students have little agency in choosing their learning pathways and are actually constrained by the retake policy. Despite the government's intent to improve mathematics skills, the majority of these post-16 students remain vulnerable, facing mathematically disadvantaged futures.

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The relationship between self-rated health and proficiency in numeracy and technological problem solving in the OECD countries

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Key words: numeracy, literacy, digital skills, self-reported health, health literacy, PIAAC

Abstract

According to Sørensen et al. (2015, p. 1053) health literacy can be defined as: "the knowledge, motivation and competences to access, understand, appraise and apply health information in order to make judgments and take decisions in everyday life concerning health care, disease prevention and health promotion to maintain or improve quality of life throughout the course of life'.

These judgements and decisions not only require literacy and numeracy skills such as understanding medical information, including medication dosages, risk levels, and nutritional facts, but also digital skills. Especially digital skills are becoming increasingly important for accessing online patient and insurance information, navigating through the health care system, and thus managing your personal health in a technological complex environment. Whereas literacy and numeracy are part of universal primary education, digital skills are not. This matter has the potential to increase inequality by creating a digital divide between people who have access to ICT and people who have not (van Dijk, 2020).

It is important to identify who is vulnerable to poor health outcomes so that relevant policy measures with respect to public health education can be developed. The first European health literacy survey (Sørensen et al., 2015) indicates that people who are financially deprived, have a low social status, are old, and have low education, are more likely to score low for health literacy and are therefore more prone to poor health. Additionally, people that have limited proficiency in numeracy and the use of digital tools may have difficulties in comprehending and managing health-related information and may therefore be more vulnerable to poor health outcomes.

International survey data from the Programme for the International Assessment of Adult Competencies (PIAAC) of the OECD, can be used to assess the level of numeracy, literacy, and digital skills of adults and relate these to health indicators. Using this data from 2015 for Germany and taking social-demographic factors into account, Heilman (2019) shows that specific numerical skills (such as estimating measurements, analyzing interpreting statistical data) are associated with healthy lifestyle and health satisfaction. Based on the data of 33

countries from the first (2011-12) and second (14-15) round, Rodgers et al. (2019) established a positive relationship between numeracy and literacy skills and self-reported health.

We extend this analysis by taking the data from six countries that participated in the third round (2017) into account and by considering the role that ICT problem solving skills (in combination with numeracy) can play in health outcomes. To do this, we take socio-demographic factors into account, and perform binary logistic regression analysis, a statistical technique that can be used to predict the outcome of a binary variable. In our case the outcome variable is self-reported health which was originally measured on a five-point scale (1=poor, 2=fair, 3=good, 4=very good, and 5=excellent) and was recoded into two categories: poor health (categories 1 and 2) and good health (categories 3 -5). The final sample size is 65,032 and consists of employed residents who are between 16 and 65 years of age and reside in one of the 26 countries for which all relevant data are available. For two countries, information on self-reported health was not available and in four countries the digital skills were not assessed. To obtain representative results each country developed a multistage stratified clustered area sampling design (OECD, 2019).

In our analysis the main predictor variables are assumed to be literacy and numeracy levels (scores were recoded into 5 levels ranging from low to high) and digital skills (these scores were recoded into four levels). Analogous to Rodgers et al. (2019) we created a combined variable telling us whether the respondent scores 1) high for both digital skills and numeracy, 2) high for digital skills but low for numeracy, 3) low for digital skills but high for numeracy, and 4) low for both skills. The socio-demographic factors are gender, age group, country of birth, highest attained level of education, parental education, monthly income percentile, and residing country).

We see that 23 percent of the respondents assessed their health to be lower than good, this percentage ranged from 11.2% (for Czech Republic) to 50% (for the Republic of Korea). Our analysis shows that 1) people who are less numerate, are more likely to report having a poor health, 2) people who are weak in digital skills are also more vulnerable to poor health, and 3) people who have a high proficiency in digital skills, but a low proficiency in numeracy is more likely to report having poor health than people with high levels of both type of proficiencies. In targeting health vulnerabilities, policies should be especially aimed at increasing the numeracy proficiency and not only the digital skills.

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Inspiring Research: Then and Now

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Introduction

Certain writings can inspire our research. Some ideas we met towards the beginning of our careers, perhaps suggested by a supervisor, colleague or student; others we discovered more recently. This workshop aims to show that their features are still important to adult mathematics researchers and students today.

We represent four countries. Colleagues are invited to join this discussion, during the conference, or through contributions to ALM's *Bulletin*, or *Journal*. Each speaker has made active contributions to our field, through their research and by supporting others' (Wedege, 2010). Each introduces one key influence from their early career, and another discovered more recently.

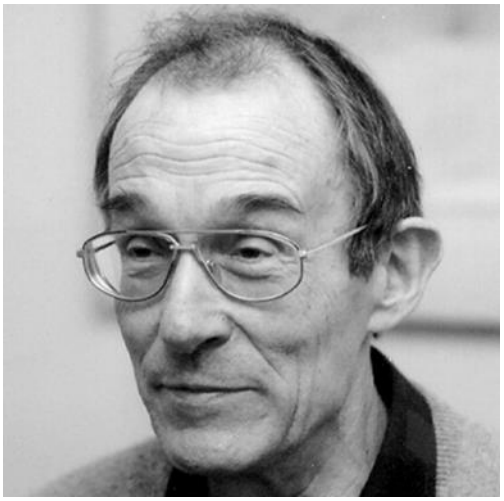
When we pooled our suggestions, we found that many of the eight researchers came from the same "family tree ". We will perhaps expand on this later, but many of our researchers had links with the anthropological studies of language and numeracy of Sylvia Scribner and Michael Cole (e.g., 1975).

Anke

Most of my students work with Klaus Holzkamp's 'socio-materialist' learning theory. Holzkamp, a German psychologist, challenged the dominant discourse (1993) on learning, although seemingly well-researched, with behaviorist and cognitive theories, both in the US and USSR. Holzkamp believed the social situatedness of action needed more attention.

Holzkamp claimed a focus on teaching risked a short-circuit in thinking of teaching and learning. Theory can specify good reasons for learning resistances from the learner's standpoint. (Why learn algebra, as long as we can estimate which prices offer a bargain?)

Adam Ries
https://de.wikipedia.org/wiki/Adam_Ries



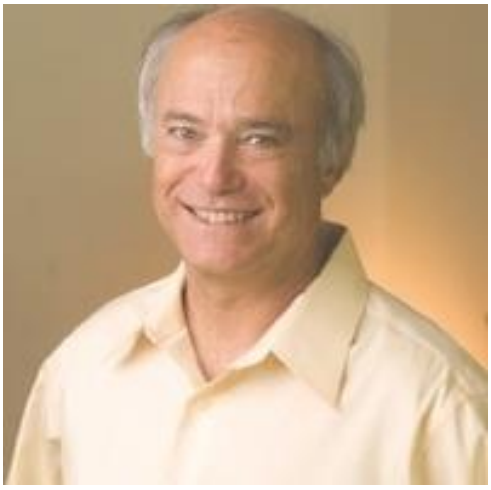
Klaus Holzkamp
https://de.wikipedia.org/wiki/Klaus_Holzkamp

When developing ideas for the Hamburg Numeracy Project, I found Adam Ries's textbook on calculation with Arabic instead of Roman numerals. He introduced Arabic numbers into German trade and craftsmanship in the 16th century. He wrote in German, like Martin Luther who translated the bible from Latin to German. [When Germans calculate in everyday situations, we say jokingly "Two plus two? After Adam Riese that's four".] What makes him relevant today is his facilitating mathematics for the common people, notably in clarifying the weight and prices of everyday necessities like bread. He also challenged the religious authorities by introducing the ("blasphemous") zero, so that the practical aspects (zero means nothing) overcame spiritual ones (zero is nihilistic and godless).

Jeff

After some years teaching "mature" adults in higher education, I met Jean Lave's work, especially *Cognition in Practice* (1988). Starting from a critique of experimental psychology studies of "learning transfer", she emphasised that thinking and learning are *situated.* She elaborated on the idea of *context* - central in adult numeracy. A social anthropologist by training, she and her students studied shopping by accompanying supermarket shoppers (i.e., *participant observation)*; and also, how people attempted to control weight in Weight Watchers.

Jean Lave
berkeley.academia.edu



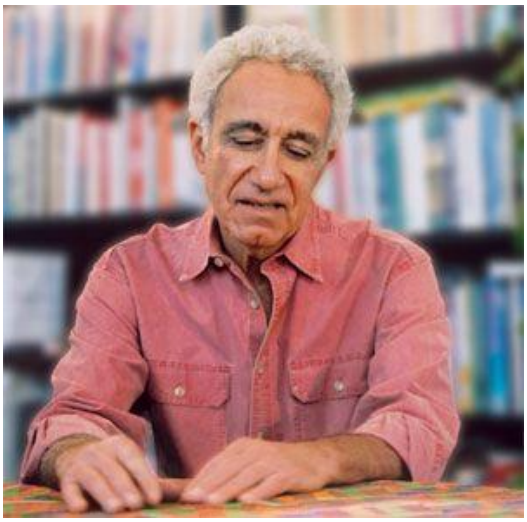
Steve Reder
pdx.academia.edu

Later, I discovered Steve Reder's work (e.g., 2011) on local literacy surveys, *longitudinal* in that they followed the same group of people over some time. Steve was able to critique the quantitative performance studies like PIAAC, while understanding their methodology well. Recently he also was involved in the US PIAAC Prison study, which used a supplementary sample of 2012 PIAAC data. He is a leading exponent of Practice engagement theory (PET), which posits that individuals' literacy proficiencies develop as a by-product of their engagement in everyday reading and writing practices and, reciprocally, that literacy proficiencies affect levels of engagement in reading and writing practices. Steve is presented here as a literacy researcher, thus indicating its importance in the foundations of numeracy research, but he would see numeracy as part of literacy, though independent.

Both researchers have made strong empirical contributions, put forward theoretical insights, and through using the comparative method; this shows their continuing relevance today.

Keiko

In the early 1990s, I was working across two faculties – Education and Engineering in my university. In Education, my colleagues and I were developing ideas about what we might mean by *critical numeracy*, while in Engineering I was reading in the Science and Technology Studies literature, which made me wonder about what a social study of mathematics might be. Ole Skovsmose's (1994) helped me pursue this inquiry. His concept of the "formatting power of mathematics" provides a lens to examine mathematics as an actor in society, influencing, for example, how much value we place on certain activities or even people's lives (insurance policies). I found this concept powerful for understand how mathematical models shape our world view. This idea was something that validated critical numeracy as relevant as much to 'everyday numeracy' of adults in community life as to the professions.



Mike Rose
http://bostonreview.net/author/mike-rose

Ole Skovsmose
https://vbn.aau.dk/en/persons/104158

More recently, I have been deeply moved and influenced by writings by Mike Rose, in education at UCLA. *The mind at work* (2004) is an ethnographic study of mainly blue-collar workers and apprentices in plumbing, waitressing, carpentry, hairdressing and more. His close, thoughtful accounts are a powerful antidote to policy-makers' reductionist understanding of the literacy and numeracy practices in the workplace. Avoiding a deficit perspective of these workers as low-skilled, Mike Rose expands our understanding of skills and brings them to life, including numeracy skills, to show how all of one's senses, aesthetics, professional pride and judgement are engaged in work. His respect for the skills of these workers is notable, in an ethnography that dignifies the work and the workers he is seeking to learn from.

Lynda

As I began my research career in adults learning mathematics, I found studies by Nunes, Schliemann and Carraher (NSC) contrasting the informal, complex and meaningful mathematical knowledge used by working children and adults with the formal mathematical learning in school. Through interviews with street venders, farmers and carpenters, the researchers revealed mathematical practices intertwined with the social situations of use, and often favouring oral and mental math (rather than written, generalized procedures from school). However, when presented with school-math problems, formally similar to those commonly found within their meaningful contexts, performance declined. Even farmers or carpenters, with some schooling, did not rely on learned school methods in their work.

These studies informed my thinking about potential disconnects adults returning to school may bring with them experiences within work or life contexts where they developed meaningful but not school-like mathematical ideas; now they learn mathematical procedures not easily transferable to work settings where other practices are the norm.

Deborah Loewenberg Ball

Terezinha Nunes (porsinal.pt)

After years of experience teaching mathematics in secondary and community college settings, I encountered the work of Deborah Ball and colleagues. They explored the question, "What do teachers need to know to be able to teach mathematics effectively?" in school contexts. Their conceptualization of *pedagogical content knowledge* is relevant with teachers of adults returning to school. Effective teachers need to know more than simply "how" to do the mathematics taught – they must be able to represent the mathematics in multiple ways to help adult students with diverse personal learning histories, both in and out of school. Also, to analyse students' explanations to decide what students are (mis)understanding, especially if their work looks different from expectation or the teacher's approach. The assessment items published by Ball and colleagues are useful examples for engaging teachers in thinking about how to make sense of students' work.

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Numeracy, social (in)equality, and vulnerability: An analysis of media items about COVID-19 and implications for adult learning

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Background

The mass media is considered the primary vehicle through which most citizens consume the news on key social and economic matters. Consequently, the nature of the knowledge and skills needed for critically interpreting media reports has been a focus of a number of lines of research enquiry, e.g., on mathematical literacy, adult numeracy, or statistical literacy (Jablonka, 2003; Geiger, 2015). This talk examines the capabilities needed to understand the mathematical and statistical information included in the COVID-19 (Coronavirus) pandemic media, given the criticality of such information for the well-being and practices of all citizens, including from vulnerable groups.

Vulnerability relates to the status of social groups that are part of society but are at increased risk of social, political, or economic exclusion or disadvantage (Gal et al., 2020). Indeed, the media news regarding the pandemic in multiple countries have repeatedly reported official statistics showing that numerous social groups (such as language, ethnic, and religious minorities) are vulnerable, with higher infection and death rates, and lower vaccination rates, compared to mainstream groups. Accordingly, we should seek ways to empower vulnerable groups (Gal, 1998; UNESCO, 2016) and develop their numeracy and statistical literacy skills in order to promote social action. Yet, despite the importance of diverse types of quantitative skills for citizens' ability to engage with information about burning social issues (Ridgway, forthcoming 2021), there is a surprising absence of systematic empirical research on the actual numeracy and statistical literacy demands in mainstream media.

Approach

We have adopted an exploratory approach and content-analysed a purposive sample of over 300 'media items' (articles, videos, podcasts) selected from four leading news sources aimed at general but diverse audiences in four countries (Australia, UK, USA, Israel) with heterogeneous demographic, geographical and economic characteristics, and different pandemic-related profiles of infection. The chosen media items appeared during the timeframe 15 March-15 June 2020, a period across which the pandemic progressed, reached its 1st-wave peak, then started to subside in many countries. About half were lead or section-lead articles, to ensure importance to readers. Our approach to content analysis involved inductive category formation, which Krippendorff (2004) suggests as appropriate when texts written about a common theme are realized by different authors. Content categories were developed through a constant comparison process, discussions between the researchers of incoming media reports, and refinement until the categories and their definitions stabilized.

Results

The results include a broad typology of nine categories (see Figure 1) of elements within the media items that require mathematical and statistical types of knowledge and skill, in order to understand the news communicated to the general public about the pandemic, as well as about the status of vulnerable groups.

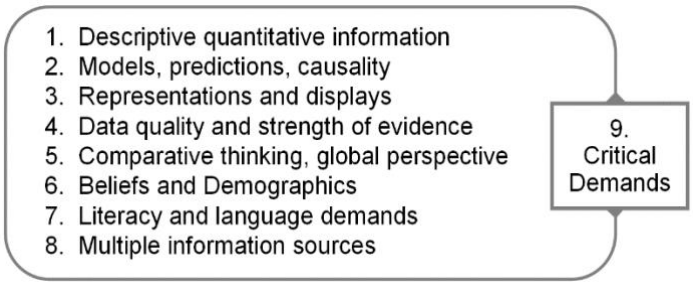

Figure 1. Nine categories of elements within the media items

Of these categories, eight are identifiably distinct but interrelated, with an additional overarching ninth element, critical demands, intertwined between the other eight elements. Most of these categories have seemingly been noted in the literature before, but all contain new or enhanced aspects that reflect salient demands in the pandemic-related news media.

These categories will be sketched as part of the presentation and accompanied by illustrations from media articles focused on the status or practices of vulnerable groups during the pandemic (e.g., differential infection or death rates, or hesitancy to comply with official guidelines). The illustrations will aim to highlight the capabilities that people from vulnerable need in order to understand their own status and risks.

Discussion

The results show that the nine categories listed in Figure 1 are far more sophisticated and multi-faceted than portrayed in previous research literature. Further, media items about the COVID-19 pandemic appear to present more holistic demands, that citizens:

- combine or integrate multiple ideas that are normally taught separately in mathematics and statistics,
- grapple with many literacy demands (e.g., comprehension of written and spoken texts by journalists and experts)
- be at ease with notions of vagueness and risk associated with statistical and mathematical products in the media.

Our sample of media items is limited given the huge volume of information in the media about the pandemic, and for now does not include reports about later stages of the pandemic, including additional waves caused by COVID-19 variants or vaccination issues. Yet, the sources used were sufficiently rich for results to contribute to new knowledge by pointing to a range of demands in the media that have not been documented in prior research.

Overall, the findings point to a range of capabilities that adults need to critically understand the media news and that can affect individual and community-level practices related to numeracy

and health, and how they cope with misinformation. Yet such capabilities are seldom fully addressed when learning mathematics and statistics, especially with adult learners. Taken together, the findings raise new questions about what it means to be statistically or mathematically literate, or numerate. Implications will be discussed regarding needed changes in current conceptual models, curricula and instructional activities, and policy-driven interventions that can reduce inequality in the public's health numeracy practices.

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Reflecting on a numeracy framework under construction

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Key words: numeracy, framework, multidimensional, higher-order skills

Numeracy is about how people deal with the quantitative and multidimensional phenomena in the world around us, both in daily-life situations and professional contexts. In the latest and most state-of-the art definitions, numeracy is described as a broad and multifaceted concept and as a social practice. It manifests itself in a plethora of observed numerate practices of people, showing that numerate behaviour is affected by cultural, social, personal, emotional traits, and societal power relations.

In 2019, funded by the European Union, an Erasmus+ project started under the name Common European Numeracy Framework (CENF) to create an overview of the relevant aspects which matter in the quality of numerate behaviour of citizen (Hoogland, Auer, et al., 2019; Hoogland, Díez-Palomar, et al., 2019). This was based on a literature review on emergent themes in numeracy, a wide-scale European Numeracy Survey, and expert consultations. The main categories of aspects which were discerned, are: Content knowledge and skills, Context, Cognitive processes (especially higher order skills), and Dispositions.

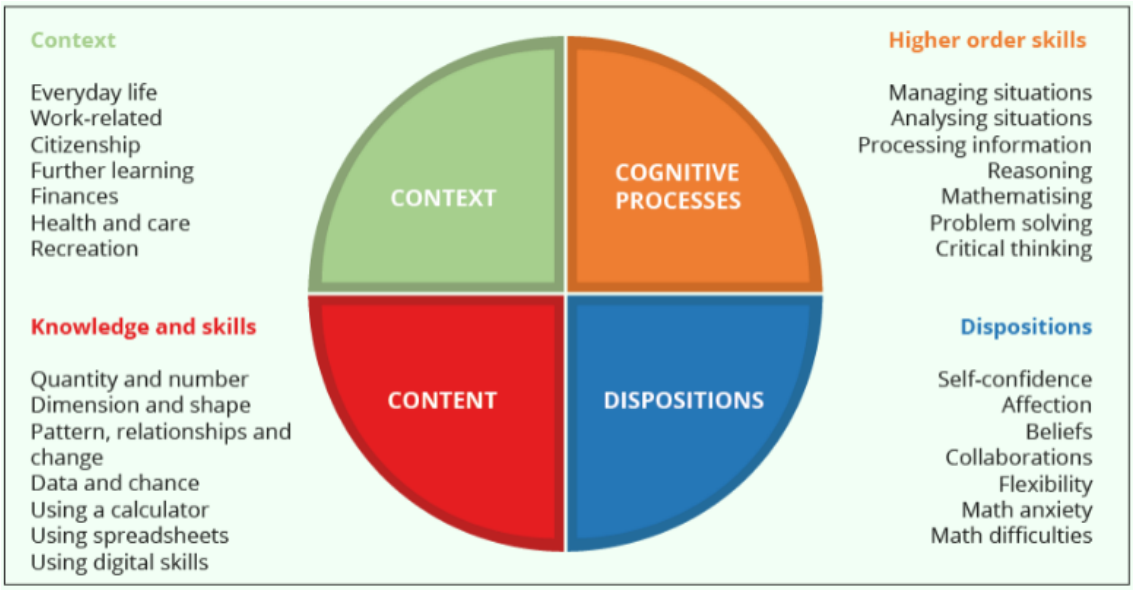

Fig.1. What matters in the quality of numerate behaviour?

In the CENF, for each category and subcategory (e.g., Quantity and Number, Self-efficacy, Mathematising) descriptions of observable numerate behaviour were developed.

The aspects which are categorised under cognitive processes and dispositions are used also quite often in educational research and literature in a generic way. They also appear in other kind of frameworks. There is, for instance, a substantial overlap of the category 'Higher order skills' with frameworks for 21st century skills (Csapó & Funke, 2017; Geiger et al., 2015; Hoogland, 2020; Voogt & Pareja Roblin, 2012). The aspects under disposition can also be found in literature on motivation in education and even more general literature on personal traits (Eccles, 1996). In this numeracy framework we have described these aspects in terms of numerate behaviour, or otherwise stated, in terms of how these aspects play out in numeracy situations.

Furthermore, the descriptors are formulated as a rubric with six levels, so that they may give indications for possible learning trajectories. By this, teachers and learners in adult education can establish together which (combinations of) aspects of numerate behaviour can be addressed to improve the quality of the learner's numerate behaviour.

The six levels are labelled X1, X2, Y1, Y2, Z1, and Z2. Roughly, the levels X refer to use of numeracy in daily-life house-hold situations, the levels Y refer to the numeracy activities of a citizen actively participating in nowadays societies, including being critical to numerate communication in news and social media, and the levels Z refer to the use of numeracy in professional settings, by users and producers of numerate communication. Clearly, there is an overlap in all these levels and activities, but the distinction is made to make it easier to have a focuses discussion on numeracy, necessary numeracy, developing numeracy skills, and improving the quality of numerate behaviour.

The rubrics are all first versions developed in recent years. The aim is to discuss them with experts, policy makers and practitioners to see whether the descriptions can be clarified, refined, and linked to educational numerate practice. So, in the workshop at this ALM conference, the participants were asked to critically reflect on the rubrics for the (sub)categories of the framework. The comments will be used for the final descriptions in the framework which is scheduled to be launched at the end of November 2021.

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Perspectives on building financial skills and knowledge with families that are described as financially vulnerable. An exploration of approaches used in Money Matters, a new EU project and community-based experiences.

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Research continues to show that families and households already facing significant financial insecurity have had their situation worsened by the economic downturn caused by the Covid-19 pandemic (OECD, 2020, Social Metrics Commission, 2020).

In this workshop the notions of financial vulnerability and the contentious role of financial education were discussed. A European Project that has been recently established to work with disadvantaged family groups to help develop their financial decision-making skills and knowledge were also discussed. In this workshop the aims and potential content of the project were discussed and compared with experiences of those attending the session from different countries who are working with people who are identified as marginalised or from vulnerable communities (Gal, Grotlüschen, Tout & Kaiser, 2020).

Financial Vulnerability

Gal, Grotlüschen, Tout and Kaiser, 2020 identify financial debt is one characteristic that indicates vulnerability. Indeed OECD (2020) research found financial vulnerability to be a significant problem across the developed and less developed world. They find 42% of individuals responding to their research, across 26 countries from Asia, Europe and Latin America felt 'financially stressed', in that they worry about meeting their everyday living expenses. Research also shows many people who are identified as financially vulnerable in the UK struggle to 'make ends meet' and rely upon different forms of debt to cover even day-to-day costs (Gathergood, 2014).

The Social Metrics Commission (2020) also found that even before the pandemic, one in five families in the UK were 'living in poverty'. Amongst these families nearly three in ten (27%) had adults who were behind with paying bills and seven in ten (70%) had no one who saved. Worryingly, they found that the impact of the pandemic has been harder for those living in deepest poverty.

Financial Education

But not all research agrees that financial education improves people's financial skills and knowledge, pointing to its limited ability to help with financial decision-making because of the complexity of financial products and services that are constantly changing (Willis, 2008). Further research observes individuals also find the financial products and services were often not easily accessible and not always trusted (Financial Capability Lab, 2018). Others point to research that shows most people's financial behaviours and habits are developed while very young and become fixed (Whitebread & Bingham, 2013), hence financial education later in life can have a limited effect. Nevertheless, the European Parliament (2015), the OECD (2020) and Lusardi, Hasler and Yakoboski (2020) still recommend financial education as one way to support individuals who are struggling to meet family budgets.

Money Matters European project

Responding to the need to support disadvantaged families who are currently struggling financially, organisations in six European countries[1] have grouped together to try to develop some family learning financial educational approaches that incorporate online resources. Funded through Erasmus+ the project is called Money Matters[2]. The project aims to use an intergenerational learning approach, focused on family groups, to help develop some useful financial skills and knowledge utilising online learning resources that include comic books, escape rooms and apps. The project started in early 2021 and finishes late in 2022.

Financial literacy, capability or numeracy?

While the term financial literacy or capability is often used Gal, Grotlüschen, Tout, and Kaiser (2020) point to substantial research that suggests the term financial numeracy might better describe the skills needed to deal with debt, comparing financial offers and understanding risks such as those involved when banking online. They also argue that,

> *'adults with lower numeracy skills are often described as vulnerable, marginalised or at high risk from being excluded from labour markets and social life' (p. 387)*

Yet an experienced manager of a local tenants' advice group in London that gives financial advice, stated she had never thought her work had anything to do with mathematics or numeracy. Her starting point was basically people have financial problems because they do not have enough money! This comment helped us to further explore the usefulness of using terminology involving financial numeracy rather than financial literacy.

The ALM 28 Workshop

Attendees in the ALM workshop explored the concepts of financial literacy, numeracy and sought to further understand vulnerability from both an academic and a community-based perspective across many countries. We also reflected on the nature of the financial problems

[1] Money Matters partners: Ireland, Cyprus, Portugal, Italy, Greece and the UK

[2] Money Matters website: https://moneymattersproject.eu

and the insecurities members of communities who might be classified as vulnerable might experience (Gal, Grotlüschen, Tout & Kaiser, 2020). One common indication was many people having little or no 'back up money' during the pandemic.

During the workshop we also explored the role that digital technology might play to support families in the development of financial literacy skills. Discussions on this topic highlighted the role of algorithms, for example, when calculating credit scores, they were often based on the applicant's address. Also, games and advertising websites were often used to 'harvest' personal details and passwords. When discussing topics for the development of on-line escape rooms for the project suggestions included dealing with scams and identifying strategies for protecting against loan sharks.

Participants recommended one set of financial numeracy skills that needed to be further developed were calculating costs of credit cards and understanding interest rates. Perhaps more worryingly one participant stated a recent Google search into videos on 'how to calculate change' identified there had been 41 900 000 hits. It would be interesting to explore further why calculating change seems so problematic.

Conclusion

The workshop helped to identify common issues that had been experienced across many countries during the pandemic but also identified issues that needed to be raised, for example project members would need to be aware of the role of algorithms in the development of online resources, as well as developing important numeracy skills when supporting a family's financial education.

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Democracy revisited – for adults learning mathematics

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Key words: mathematics instruction; democracy; educational environment.

Connections between numeracy and vulnerability may become more profound and visible in a crisis like the pandemic. In addition, connections between numeracy and citizen's factual and potential participation may become more visible. I look into a broad concept of democracy and reflect – again – on relations between democratic processes and mathematics and numeracy teaching. I suggest a matrix model to inform further discussions and experiments. The model has two dimensions. In one dimension you see formal representational democracy as a form of rule versus informal democracy with participation and communication as a form of life. The other dimension highlights the classical didactical questions, above on what mathematics to teach and below with how to teach mathematics?

Introduction

The context is adult education in Denmark. The long-standing tradition of adult learning in Denmark underlines in its written founding documents to empower adults and encourage them to participate in democracy and to offer instruction which appeals to participants' active involvement. As many share these ideals the world over, I think the following three questions are worth to explore for ALM, especially in a time of crisis like the pandemic:

1. What can participation in numerical practices for democracy mean in today's societies?
2. How can you demonstrate and enhance adults' numerical practices in instruction for democracy?
3. How can democratic aspects of numerical practices be documented in large-scaled and small-scaled studies?

My presentation at ALM-28 built on the idea of the first question. I assumed that citizens' participation and non-participation in numerical practices for democracy have important societal effects as well as personal effects, so the theme mathematics/numeracy and democracy is worth examining. However, I did not discuss the societal and personal effects further. The focus of the presentation was on the second question about instruction, where I investigated what demonstrated and enhanced adults' numerical practices might look like through democratic lenses. I started with looking back into earlier educational scholars' writings and ended up suggesting a matrix model to inform further discussions and experiments on democracy and mathematics/numeracy instruction for adults. The presentation did not focus on question 3.

Methods

I developed the model as part of a collective effort among colleagues at the Department of Educational Theory and Curriculum Studies. At the annual working seminar 2017, we decided to write an anthology on democracy and subject didactics [in German: Fachdidaktik).

I therefore studied – once again - Nordic understandings of mathematics education for democracy from around 1990 (Mellin-Olsen 1987, Niss 1994, Skovsmose 1990). Also, I looked again on my own recent analyses on Danish curricula and public discussions (Lindenskov 2018, 2019). I then investigated what critical mathematics studies reveal today about mathematics and democracy, and it seemed to me that earlier focus on democracy has been replaced by other themes. Yasukawa et al. (2018) have thirteen contributions on numeracy as social practices seen through four lenses. I remarked that democracy as a theme occurred in a contribution from South Africa and one from India, but not in any of the rest. Still, the publications distil several issues, which contributes to what I see as 'lived democracy'. In addition, one issue in Berry III et al's 'social injustice' framework (2020) is formal voting systems, which all build on algorithms. From reflections on this, I constructed the matrix model (Lindenskov, 2020).

Result: the matrix model

Hoogland declares (2019, p. 131) 'a growing consensus that a numeracy framework which describes numerate behaviour and numeracy practices should contain much more than only content descriptions. As important are dispositions, attitudes, higher order skills, and aspects of agency, and self-efficacy.' In line with this declaration, the model includes issues of content, but not only issues of content. Horizontally, the level above concerns issues of content, and below the model has issues of democratic access and democratic learning processes with the intention to let students redefine dispositions and attitudes and develop higher order skills, and aspects of agency, and self-efficacy. So above concerns the question of what to teach, below the questions of who to teach and how to teach.

It is for sure that simple school arithmetic is insufficient content. As stated by Steen (2001):

> *Today's well-educated citizens require sophistication in both literacy and numeracy to think through subtle issues that are communicated in a collage of verbal, symbolic, and graphic forms. In addition, they need the confidence to express themselves in any of these modern forms of communication. In the twenty-first century, literacy and numeracy will become inseparable qualities of an educated person. (p.9)*

Vertically the model distinguishes between formal democracy and lived democracy. Back at ALM-8, Paola Valero and I termed the two democracies Democracy 1 and Democracy 2 (Lindenskov & Valero, 2001). The model presents formal issues of democracy to the left. To the left above, politicians and government departments decide formalities of existing voting systems. The systems differ from country to country and the systems are reshaped from time to time. Nevertheless, they all rely on mathematical algorithms. It is an obvious option to invite adult learners to re-calculate a national election according to another nation's algorithms. Probably you would get a quite different Parliament.

To the left below they decide who has the right to get quality mathematical education. A democratic mantra may sound like that anyone has rights and access to acquire appropriate mathematic expertise and authority. History – and today – show many examples of unequal access and unequal opportunities to learn. To the right side, the model presents the lived life, where democracy is a 'way of life' rather than a form of rule (Jakobsen, 2010). Above at the right side we look into how democracy 'is being done' on a daily basis in public conversations, in so me or in person-to-person conversations. Much background information for political decisions locally, nationally, and internationally includes numerical measures and mathematics problem solving and modelling results.

To the right below the focus is on if and how mathematics lessons are being lived democratically? How is educational environment for mathematics/numeracy learning? Do we have 'lived democracy mathematics classroom', meaning that students and teachers exercise freedom of opinion, discussion, tolerance, critical attention, trust, and justice? Just as well, do students have the right to expect to be valued and to experience mathematics as meaningful?

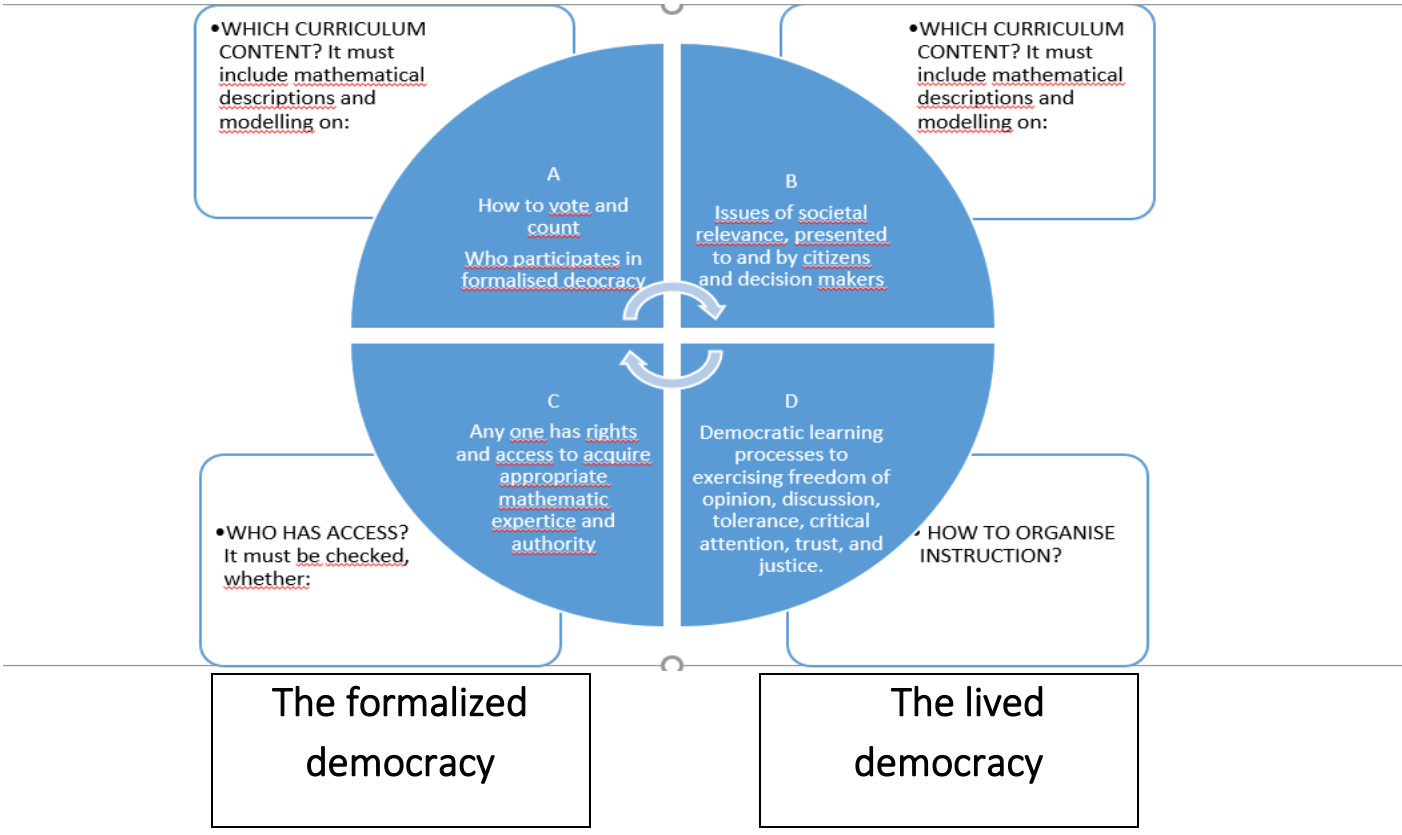

Figure 1. *Matrix model for mathematics/numeracy instruction and democracy.*

At ALM28 I exemplified instruction in each area. For instance, in area A adult learners can compare effects of different voting algorithms from Denmark and other countries:

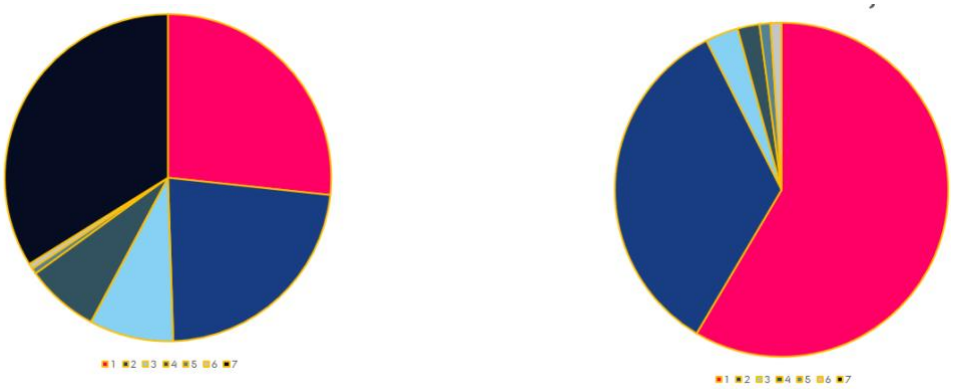

Figure 2. *Actual Party representatives in Danish Parliament 2021 (left). Hypothetical Party representatives in Danish Parliament 2021 with algorithms in GB and USA (right).*

Discussion

In my view, Nordic understandings of mathematics education for democracy from around 1990 (Mellin-Olsen 1987, Niss 1994, Skovsmose 1990) still have meaningful messages for today, although they primarily describe area B in the matrix model. Having newer analyses in mind as they touch all four areas, I think, it is timely to revisit democracy and mathematics relations more deeply, both by research and by instruction practice, than was possible for the ALM-28 presentation. My model proposes a structure for such a revisit.

A member of the audience remarked that the terminology Democracy 1 and Democracy 2 may be fruitful and may enhance our reflections on the societal, both versus and together with, the individual demands and wishes. In my view there is a tendency to put too much weight on demands, and too little on wishes. Hoogland (2019, p.54) shows that society 'demands' certain numerate behaviour of individuals and shows citizenship as one of seven contexts with 'situational demand'. Using concepts of democracy clarifies, in my view, that in most cases people are the actors that formulate and interpret 'demands', individually as well as in calmful collaboration and fierce fight with one another.

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Immigrant students' perspectives on language and mathematics learning in mathematics classrooms

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This paper explores newly immigrant students' perspectives on mathematical and language learning in mathematics classrooms in International Preparatory Classes[3]. Insights into students' perspectives on their own learning processes provide a basis for building on students' competencies. For the present study, interviews were conducted with 13 students from International Preparatory Classes, which were analysed using grounded theory methodology.

Study background

The study is embedded in the Hamburg Numeracy Project, which aims to explore the numeracy competencies and practices of vulnerable groups (e.g., migrants, financially over-indebted people, and students with learning difficulties). Mathematics competencies, as they are developed in the school context, are of crucial importance for numeracy competencies and practices. Refugee children and young adults are seen as a vulnerable group with a diverse range of special needs. At the same time, many of them possess prior education (i.e., rich multilingual knowledge, advanced mathematical competencies). As studies have shown, exploring immigrant students' perspectives can offer possibilities for addressing students' competencies as a resource in the classroom (Dirim & Heinemann, 2016). For mathematics education in German-speaking countries, there have been few studies to date regarding students' perspectives on learning in international preparatory classes. Overall, research and public discourse on immigrant students are characterized by a perspective not acknowledging the resources of the migrant students (Chlosta & Ostermann, 2008).

Data and methods

The interviews were open-ended, and the questions focused on the students' experiences in mathematics classrooms in their country of origin as well as in the International Preparatory Classes. Since most of the students had already been in Germany for about one year, they had a solid knowledge of German, which made it possible to conduct the interviews in German

[3] In International Preparatory Classes, children and young adults with refugee or migrant backgrounds learn German and are prepared for the German school system.

without difficulty. The students were 14 to 18 years old, came from different countries of origin and had heterogeneous school experiences (see Table 1).

Participants		
Pseudonyms of the students	Origin country	Experience with mathematics education in years
Dunja	Serbia	8
Amir	Afghanistan	0
Malia	Afghanistan	6
Nesrin	Iran	5
Basir	Afghanistan	7
Kenan	Syria	9
Fahrid	Syria	0,5 (Alphabetization classes in Germany)
Athra	Syria	9,5
Milena	Bulgaria	9
Zohra	Afghanistan	8
Mowgli	India	10
Leander	Macedonia	9
Enis	Syria	1,5

Table 1: Participants' data

Results

In the analysis of the interviews, several central topics were identified that characterize students' perspectives on learning processes in the mathematics classroom in the International Preparatory Classes. We address two of these topics within this paper.

The relevance of language in mathematics classrooms

The students described the relevance of language in mathematics classrooms. They particularly pointed out their language-related difficulties in understanding word problems. Some students said that if they understood the text of a task, they would know how to work on it.

> *MALIA: Exactly, we can't understand the text so well, what we have to do (..) what do we have to do. For example. Because of the task text. If we can understand the task text, then we are able to.*[4]

Malia reported here that they were able to work on a task once they had understood it language-wise. In Malia's view, language understanding and mathematical understanding seem to be closely related. This is interesting since research in mathematics education points to the central role of linguistic competencies for mathematics learning (Leiss et al., 2019), which is however

[4]Students' quotes are translated from German to English by the authors

quite often denied by students or teachers. Contrary to the assumed low importance of language for mathematics learning, the understanding of linguistic constructions is often fundamental for mathematical comprehension. In their interview responses, the students often do not distinguish between language learning processes and mathematical learning processes. Some statements, such as Malia's, even describe the two processes going hand in hand. The connection between linguistic competencies and mathematical understanding could be reflected upon in the classroom to develop common strategies for language learning as well as mathematical learning. These strategies could, for example, consist of not only clarifying the meaning of individual words when working on word problems, but also specifically identifying and discussing linguistic constructions for describing mathematical structures.

Calculation methods from countries of origin

During the interviews, many students explained in detail how certain calculation methods, which they had learned in their countries of origin, work in contrast to the methods they learn in the International Preparatory Classes. The students reported that they still use the calculation methods from their countries of origin.

BASIR: For example, my mother showed me a few ways that, for example, Germans don't know. Germans have a different way, but I go from different way. But we get, get only one result.

Addressing, comparing, and discussing different calculation methods could play a greater role in the mathematics classroom of the International Preparatory Classes. The mathematical knowledge that immigrant students bring with them represent a resource for further developing mathematical understanding on the one hand, while also stimulating language learning processes on the other. For example, the students could present and explain to their classmates' ways of calculating that they learned in their countries of origin.

It is also interesting that the students reflect that the methods are different, but the results are the same.

ZHORA: Formulas are the same. But calculation and explanation are different.

Zhora's perspective reflects an overall view on mathematics as a discipline, which could be addressed in the mathematics classroom of the preparatory class. It could be discussed why there are differences in calculation methods when mathematics is considered as universal.

The mathematical skills of the students are a resource for interesting perspectives on mathematics and at the same time a possibility to appreciate the students' competencies.

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"What am I doing here?" Perceptions of Zimbabwean adult numeracy learners in England

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Abstract

Adult numeracy is one of the main education provisions geared towards improving adult life skills in England. Migrants from across the world participate in adult numeracy courses. This study investigated the views and experiences of Zimbabwean adults who engaged with the numeracy curriculum in England. Data was collected through questionnaires and interviews with learners from three Adult Education Centres in England. Participants compared their learning of numeracy in England with learning mathematics in Zimbabwe. Findings suggest that most participants believed that they already possessed higher mathematical skills than those offered in the adult numeracy or Functional Skills Mathematics in England. Participants expressed disappointment in non-recognition of their Zimbabwean qualifications for progression into higher education in favour of level 2 Adult numeracy or Functional Skills qualifications. Within the numeracy classroom, participants found themselves confronted with social and cultural barriers such as contextualized tasks based on British context and language rather than mathematics skills which some described as easy, watered down and non-academic.

Key words: adult numeracy, Zimbabwean migrant learners, prior learning, international qualifications

Introduction

Previous research suggests that one in five adults in England lack sufficient literacy and numeracy skills for employment and daily activities (DfES, 2006; Marsh, 2011; OECD, 2013). Different adult numeracy strategies have been implemented in England which include Skills for Life and the current Functional Skills. Skills for Life was launched in 2001 for improving adult literacy and numeracy skills. Functional Skills Mathematics introduced in 2012, provides practical numeracy skills needed for people to operate effectively and independently in everyday life and work. Level 2 Functional Skills qualification is comparable to General Certificate in Secondary Education (GCSE) grade 4 (O'Farrell, 2017).

These strategies emerge from skills surveys and reviews such as the Wolf review of 2011 and PIAAC. However, little research has been done on how these strategies support skills development of the migrant adult population and how migrants navigate through them as they

draw their prior knowledge from different curricula delivered using different pedagogical approaches (Jurdak, 2020).

Mixed method research design

To learn about the experiences and beliefs of Zimbabwean adult numeracy learners, a mixed method approach was adopted (Mertens, 2015). An exploratory focus group and a questionnaire survey were used to obtain a broad picture, followed by interviews to obtain richer, more in-depth, and more open-ended accounts (Denzin & Lincoln, 1998; Bernard, 2000).

Snowball sampling was adopted to reach out to the research population scattered across England (Noy, 2008). Adult numeracy tutors with Zimbabwean students in their classes were also interviewed, thus providing an opportunity for triangulation. With an interpretivist perspective underpinning this research, an inductive approach was taken to identify patterns observed from the data for analysis and to construct a meaningful account of the lived experiences of the participants (Strauss & Corbin,1998, Charmaz, 2006).

Findings

Findings suggest that most participants believed that they already possessed higher mathematical skills than those offered in the Adult numeracy or Functional Skills Mathematics in England. Participants expressed disappointment in non-recognition of their Zimbabwean qualifications for progression into higher education in favour of level 2 Adult numeracy or Functional Skills qualifications. Bongi, who holds a level 2 numeracy qualification from England and an 'A-level' qualification from Zimbabwe put it this way:

But sometimes if you check whether you have done 'A' level or 'O' levels or whatever, when you come here (England) they will tell you that you did not do this here… (focus group lines 254- 257)

On a similar note, Farai brought out the theme contained in the title of this abstract and she put it this way:

Yah for example people come here with high levels of mathematics but they are placed in level 1 or level 2, then they say, 'What am I doing here?'

Within the numeracy classroom, participants found themselves confronted with social and cultural barriers such as contextualized tasks based on British context and language rather than mathematics skills which some described as easy, watered down and non-academic. An example of a cultural context barrier was alluded to during the focus group discussion when one participant made reference to a numeracy task on cooking a turkey. A turkey is not a familiar dish in Zimbabwe and the learner could not understand how it came into a numeracy lesson. However, participants favoured the learner-centred approach to the teacher led approach often accompanied by corporal punishment in their early years of learning in Zimbabwe.

Discussion

Zimbabwean adult numeracy learners in England demonstrated levels of anxiety and vulnerability within the classroom and society at large. The requirement for them to do numeracy courses which they consider academically lower than their prior Zimbabwean qualifications seemed to raise feelings of colonial legacy. Returning to education as adults to encounter different teaching and learning methods is in itself intimidating (Chinn, 2017).

These learners found their qualifications not valued and had to persevere in unfamiliar classroom situations, going through what they already know in order to fit into the education and work environment as they have no control over what counts as acceptable knowledge and work experience.

Historically, these learners come from an education system introduced by prestigious British education bodies such as Oxford and Cambridge University and the 'O-Level' qualification from Zimbabwe would not be any lower than the current British GCSE qualification.

Other negative themes cited by participants include the use of localized unfamiliar contexts, the use of games which they describe as childish and the teaching methods which differ from the rote learning they often experienced in Zimbabwe.

Conclusion

The results of this inquiry suggest that participants engaged with numeracy courses by social compulsion rather than by individual need. They felt that their prior knowledge was higher than that provided by adult numeracy courses in England yet not recognised. Participants Contextualized tasks and the use of games were barriers to a watered-down mathematics course.

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‘Helpless around mathematics’ – an examination of the impact of high levels of mathematics anxiety on adult learners

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Key words: numeracy, framework, multidimensional, higher-order skills

Adult learners who have had adverse past experiences of mathematics can find it difficult to face situations involving mathematics and numbers. These experiences can give rise to mathematics anxiety (MA), comprising intense negative feelings towards the manipulation of numbers in academic and everyday contexts (Richardson & Suinn, 1972), and influencing how learners approach the subject (Boaler, 2010). Adult learners with high MA often perceive themselves to be incompetent or helpless around mathematics, and powerless to escape such circumstances (Allen, 2016; Goodall & Johnston-Wilder, 2015). Past negative experiences involving mathematics at home or school can compromise academic success with long-term effects (Boaler, 2010). If a parent has MA, it is likely that their child will have a predisposition towards MA lasting into adolescence and adulthood (Batchelor, Gilmore & Inglis, 2017). Negative evaluation and feedback from teachers impact adversely on the child’s attitude towards mathematics throughout their schooling and beyond (Ryan, Fitzmaurice & Johnson, 2019).

The intensity of MA varies among learners; high MA can materialise as fear or panic around mathematics (Buxton, 1991; Chinn, 2017); or give rise to retrospective feelings such as math abuse (Fiore, 1999) where negative past experiences of mathematics were accompanied by verbal or physical abuse; or mathematics trauma (Allen, 2016) whereby the circumstances for doing mathematics in the past were distressing or threatening. The association of these emotive words with mathematics reveals the impact the subject can have on individuals who feel helpless around mathematics (Allen, 2016). Consequently, the ensuing difficulty in doing mathematics results in a heightened level of MA, with the adult learner resorting to coping mechanisms to get through their mathematics content (Safford-Ramus, 2008), such as learning off content without understanding (Illeris, 2007); avoiding mathematics support (Fitzmaurice, Mac an Bhaird, NíFhloinn & O’Sullivan, 2015) to avoid running the risk of looking stupid (Boaler, 2010); being strategic with assessments, and an emphasis on wanting to pass (Ashcraft, 2002; Chinn, 2017).

In order to ascertain the impact of high MA on adult learners and to address the dearth of research in this area in an Irish context, the study comprised a sequential mixed methods design using the Mathematics Anxiety Scale U.K. (MAS-UK) (Hunt, Clark-Carter &Sheffield, 2011) followed by mathematics life story interview (Ryan, 2019). The sample comprised 20 undergraduate adult learners in higher education (HE) programmes in Ireland. Three of the cohort were identified as highly mathematics anxious – determined by the MAS-UK – and were invited to be interviewed individually to share their mathematics life stories. Correlation between MAS-UK scores and gender was not statistically significant.

The findings show that past experiences substantially impact on the highly mathematics anxious adult learner's predisposition to being anxious about mathematics; for these students their dislike of mathematics is long-term and deeply rooted (Ramirez, Shaw & Maloney, 2018). Their adverse experiences stemmed from both home and school environments; themes common to all three students corroborate the literature and include a lack of parental engagement with mathematics; repeated failure in school mathematics; feeling stuck or left behind and unable to catch up; the sense that the teacher did not care; being in the lower ability mathematics class and comparing with the 'good kids'; the sense that higher ability classes had better mathematics teachers.

Despite being highly anxious about mathematics, two of these adult learners persevered and passed their mathematics modules and demonstrated resilience in spite of the challenges. They employed strategies to accumulate marks during the semester to help them pass. Neither student sought mathematics support. The third student deferred her place in HE after six weeks, and subsequently availed of one-to-one tuition to build her confidence in mathematics before returning to HE.

Proactively addressing those factors that impact on performance and achievement in mathematics requires acknowledgement by mathematics educators of the extent of MA among adult learners; and adult learners need guidance to avail of supports needed to overcome the limitations of high MA. If failure is viewed as an effective way to address helplessness around mathematics (Goodall & Johnston-Wilder, 2015), the impact of past failures needs to be part of the conversation with high mathematics anxious adult learners as they undertake mathematics modules in HE. The methods employed in this study proved effective in determining those highly mathematics anxious students and affording them the opportunity to talk about their past experiences with mathematics.

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Numeracy practices and vulnerability under conditions of limited financial means: "Without money, you can't survive or do anything or develop yourself"

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Dealing with limited financial means is of particular interest considering its significance for participation in society and for unfolding personal interests and objectives. Moreover, it elicits numeracy-related abilities and potential vulnerabilities which we would like to elaborate on with regard to over-indebted adults and adults with learning difficulties (also known as intellectual disability) in the context of their numerate environments (Evans et al. 2017).

To this end, we draw on findings from two qualitative research projects conducted in Germany, tackling the issues of numeracy practices of adults with learning difficulties (Schreiber-Barsch et al. 2020), on the one hand, and of over-indebted adults (Angermeier/Ansen 2020), on the other hand, by following these two research questions:

- In which ways do adults with learning difficulties engage in numeracy practices in their everyday contexts? To what extent are their numeracy-related abilities mirrored in these practices? What are the meanings these adults ascribe to their practices? (Schreiber-Barsch et al. 2020)
- What are the meanings of everyday mathematical practices in processes of over-indebtedness? (Angermeier/Ansen 2020)?

Considering the limited extant knowledge regarding the numeracy practices of adults with learning difficulties and of over-indebted persons, both projects opted for applying a bottom-up approach (Evans et al. 2017, 18) and followed a qualitative research paradigm (Creswell 2003, 198–199).

To analyze numeracy practices of adults with learning difficulties, the research design combined principles of participatory research (von Unger 2014; Walmsley and Johnson 2016) with grounded theory methodology (GTM) (Strauss and Corbin 1990; Strübing 2014). For this, we used the shadowing method for in situ explorations of numeracy practices in the contexts of housing situation, education, employment and free time, conducted semi-structured interviews with these adults in order to identify subjective descriptions and attributions of meaning as well as socially embedded motives, and, finally, applied focus groups with professionals of the social support system asking about potentials and limits of professional support for unfolding and engaging in everyday numeracy.

To analyze everyday numeracy practices of adults in a situation of over-indebtedness, the research design implied, in a first step, focus groups with professionals working in debt-counselling services based in Hamburg and in Munich, and, in a second step, semi-structured interviews with clients of these services. For analyzing the data, the qualitative content analysis by Kuckartz (2018) was used. Professionals working in debt-counselling services were seen to provide not only a first access to a hard-to-reach clientele, but also rich knowledge on numeracy-related issues within precarious situations of over-indebtedness and under the aim of offering professional support and counselling. Based on this, clients of these services were interviewed with regard to their daily numeracy practices.

Thus, the paper brings together findings on two groups of adults that both live in numerate situations characterized by a most likely high level of exposure to risks and vulnerabilities (Burghardt et al. 2017), as one interviewee with learning difficulties had pointed out with regard to his/her disposal of financial means:

> *I mean, that makes everything possible that you have, an apartment, food, clothing, free time. In our time ... Without money, you can't survive or do anything or develop yourself. (I_1, (#01:00:19-1#))*

Adults with learning difficulties receive, if at all, only a small income from e.g., an employment in sheltered workshops (BMAS 2016, 119–124, 222, 196), and moreover, often experience a high dependency on pedagogical assistance across their life course. Over-indebtedness, on the other hand, strongly influences all aspects of daily life. It noticeably limits the adults' possibilities and choices to participate in society and leads to major impacts on housing, health, social and working life (Peters and Größl 2020, 16-40).

Taking this into account, we focus the paper on numeracy practices in dealing with limited financial means. We aim to compare the findings of both groups with regard to their financial situation and numerate environments and, furthermore, to their respective numeracy-related activities (events) and strategies. In our view, it is crucial to highlight individual strategies and manifold resources (beyond only material goods) for dealing with limited financial means in order to provide evidence for these abilities in spite of low income, vulnerable living contexts and, often, stigmatizing attributions made by professionals and society at large. To this end, we recognize the per se vulnerability as a human being and the potential of every human to unfold abilities, e.g., by engaging in numeracy-related activities. In conclusion, we aim to highlight the emancipatory potential of numeracy (Craig 2017) for adults' lifelong learning and participation in society.

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Adults (19+) studying GCSE Mathematics in Further Education (FE) Colleges in England: Confidence, anxiety and performance

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Introduction

GCSE Mathematics is the age-16 school general qualification and is often a marker examination for university entrance. In England in June 2020, over 30 000 learners of 19 years or more were enrolled for the Level 2 GCSE examination in mathematics (Gov.UK (1), 2020), as a grade 4 or better can be an entrance requirement for university places. Many of these learners may have left school at 16 years old with a range of Level 2 qualifications, and some may not have English as their first language or may not have been educated in the UK.

Adults who re-engage with mathematics after a break can do so for many reasons, including career changes, which can expand opportunities and enhance earnings (Griffiths & Stone, 2013). Success in mathematics, combined with "Access to Higher Education" courses, can lead to professional training as nurses, teachers or social workers. In turn this can ensure more secure employment, potentially reducing adults' economic vulnerability.

Previous practitioner- based research with adults revealed levels of anxiety about both mathematics and examinations (Ashcraft, 2002; Richardson &Suinn, 1972). This has led to a mixed method investigation (Biesta, 2017) to gather learners' confidence and anxiety levels, using a questionnaire based on a number of pre-existing surveys (Evans, 2000; Hopko, Mahadevan, Bare, & Hunt, 2003; Swan, 2006). Using thematic analysis (Braun & Clarke, 2013), learners' perceptions will be compared to examination performances to evaluate for correlative links, via learner characteristics, such as age, gender and first language.

This investigation is for a Doctorate in Education. The data presented here comes from the pilot study, and I will discuss implications for moving into the main study phase.

The Pilot Study

The pilot study was undertaken with 20 participants, who were asked to complete ten questions using a Likert scale. The questions were taken exclusively from the AMAS questionnaire (Hopko, Mahadevan, Bare, & Hunt, 2003), with the addition of a question on how the learners felt generally about examinations, so that this could be compared with how they felt about maths exams. There were also some lines added below each question for participants to make comments, to add to the qualitative contribution of the questionnaire. To present a more positive image, the scale was altered from 'no anxiety' through to 'very anxious', and instead I inserted 'very confident' at the start and finished with 'very anxious.'

The participants made a range of both positive and negative ratings of anxiety in the different contexts described in the questionnaire, except for comments on the mathematics examination, which were almost all negative, and the anxiety scores for all aspects of testing were generally higher than questions on other aspects of the maths course, such as course content.

GCSE examination grades consist of an ordinal scale of 1 to 9, where 1 is the lowest grade, and 9 the highest. A grade 4 or better is seen as a pass. When the participants' GCSE exam grades were related to their overall rating on the questionnaire using a scatter graph, there was a slight correlation, and the more anxious learners were less likely to pass. However, when gender was considered, males had a stronger correlation of exam grade with maths anxiety than females, so the responses by females were more mixed, regardless of their grade.

There was a further issue when results were split by age. The midpoint value (MPV) was used for this calculation, and it was 38.5 years. The scatter graph for older learners revealed that the correlation contradicted previous analysis, as the more anxious were now more likely to pass, rather than fail.

It is important to acknowledge that there is little that can be gleaned from these results, as the numbers involved are too low for quantitative analysis, but in the pilot study I was testing whether this type of analysis could lead to some useful insights.

The pilot study revealed two further points of interest:

1) The average age of the participants in the pilot study was many years older than the average age of adults in my classes, revealing a potential volunteer bias (Spiegelhalter, 2019).
2) The GCSE exam results of the participants did not reflect the results of the cohort of adults as a whole: 20% of those who participated in the pilot study achieved the grade 4 or better, verses 60% who passed overall in England, perhaps indicating that those who were more confident were less likely to participate, assuming that there is a relationship between confidence and performance.

As a result, the questionnaire has been altered in a number of ways, including separating self-efficacy (the participants' belief in their ability to achieve the tasks or pass the exam) (Bandura, 1997), from anxiety (Richardson &Suinn, 1972), rather than placing confidence and anxiety on a single scale. This is to obtain a more nuanced feel for adults' perceptions, and so that those who feel both confident about their ability and anxious can express themselves.

The pandemic has slowed the progress of the investigation, as approvals and revisions have been delayed. It has also had an impact on the number of participants for the questionnaire, which is well below the target number of 125. This has led to the project becoming more qualitative, and interviews are now planned to supplement the data collected so far. I have also extended the deadline on the doctorate to enable a further recruitment of participants next academic year.

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