Exploring Student Attitudes and Institutional Challenges in Advancing Adult Numeracy: Insights from Focus Groups

Debi Howarth[1], Raquel Salmeron[2] & Linda Galligan[2]
[1]Torrens University and [2]University of Southern Queensland
Australia
Deborah.Howarth@torrens.edu.au

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Introduction

Academic numeracy is vital to the success of the adult learner in tertiary and professional environments. Thus, tertiary educators, including study support staff, require a deep understanding of the multifaceted nature of adult numeracy, including its key elements of competency, confidence, and critical awareness (Galligan, 2013a), within specific discipline contexts.

This contribution demonstrates the essential facets of an Academic Numeracies Framework (the Framework), and presents progress in its development, as part of an Australian research study which aims to provide tools and knowledge to facilitate the systematic embedding of numeracy in tertiary courses, programs and study-development initiatives. It is proposed that the Framework will support the development of mathematical skills in various contexts. This significant undergraduate skill gap has been reported worldwide (Faulkner et al, 2014; Buchele et al, 2023).

While Australia has seen explicit policies around widening participation in higher education since 2009 (Gale & Parker, 2013), more recent initiatives have seen the widespread removal of explicit mathematics prerequisites across undergraduate programs. The result is a highly diverse student demographic (Faulkner et al. 2014). However, universities must now identify skill gaps, and then embed various support programs tailored to the student and the degree where the mathematics skill is needed (such as engineering, nursing, and accounting). While this can result in a better experience for the student, the development and implementation of programs takes careful planning. The use of a tool such as the Academic Numeracies Framework aids educators in recognising what is required of students throughout their learning journey and scaffolding that learning accordingly.

The paper presents preliminary focus-group findings and next steps in the study, including the place of student dispositions in the Framework and guidance on how tertiary educators, including study support professionals, can use the Framework to address institutional challenges.

Background

While numeracy is defined broadly in the sphere of general life skills, academic numeracy is more narrowly defined as the "capacity to confidently and competently use mathematics at university level, and to be able to apply, interpret, critique and communicate mathematical concepts in particular disciplinary contexts" (Brady 2016, p.176). Moreover, while foundational mathematics skills may look similar across disciplines, each discipline has its own mathematics' culture and characteristics. Therefore, educators need to understand the metaknowledge around different mathematics skills and the discipline discourse that accompanies skill development. In addition to competency, confidence and critical awareness (of the mathematics needed in a chosen

discipline and students' own mathematical knowledge) are integral to being numerate (Galligan, 2013a). Moreover, Peters et al. (2019) reported that both objective numeracy and self-efficacy are important for an individual to attain numeracy benefits, with a mismatch in these elements leading to poor life outcomes.

The academic numeracy needs of students are evolving. The development of numerate individuals is fundamental to a data-oriented world and higher education has a key role to play in supporting students to be numerate, through implementing strategies and programs which go beyond non-compulsory, supplementary support and are embedded in the curriculum. There is a pressing need for adult students to have digital and appropriate academic numeracy skills and these should be intentionally placed within course work (Dalim et al., 2023). Numeracy needs to be systematically recognised and embedded in course content and support interventions across higher education.

A compounding factor is that adults have a complicated relationship with mathematics and numeracy that lies outside of mathematical competency alone, and the affective domain cannot be ignored (Hoogland & Díez-Palomar 2022). The adult student not only requires support in gaining relevant numeracy skills and knowledge, but also consistent and persistent encouragement to manage their learning through accessing attitudes and dispositions critical to becoming numerate. Attitudes and dispositions play a crucial role in determining the success of students in mathematics-related university subjects (Mzomwe, et al., 2019). Therefore, fostering positive attitudes and dispositions is essential in overcoming challenges, embracing learning opportunities, and achieving academic excellence.

Method

The research study uses an action research methodology, coupled with a mixed-methods analysis, to progressively deliver a mature Framework incorporating the elements of competence, confidence, and critical awareness. Three focus group sessions were conducted with academic (first year and pathway) educators and learning development staff from three regional Australian tertiary institutions. The sessions investigated how the Framework might help identify and address numeracy issues, including student dispositions and institutional challenges. They also explored the benefits of using the Framework, how participants envisaged they would use it, and suggestions for improvements. The sessions were conducted by an independent facilitator, and transcripts were coded using a hybrid scheme (Azungah, 2018), with categories based on the research questions, as well as the themes emerging from participants' responses.

The current version of the Framework incorporates the following elements:

1. Processes to engage with, and solve, mathematical problems: Formulating mathematical problems; Using mathematical concepts, procedures and reasoning to solve problems; and Interpreting, applying and evaluating solutions.
2. Competencies needed to complete these processes effectively: Communication; Mathematising (transforming a contextualised problem into a mathematical problem); Representation; Reasoning; Devising strategies; Using symbolic language and operations; and Using mathematical tools.
3. Numeracy Levels, specifying the level of proficiency in these competencies. Level 1 (Scaffolded) and Level 2 (Supported) refer to the competency to solve problems within a mathematical topic. Level 3 (Supervised), and Level 4 (Independent) focus on the competency to solve applied problems.
4. Numeracy Descriptors, which describe the proficiency expected for each competency, at each numeracy level.

The Framework presents these elements in a convenient format, as seen in Figure 1 (for the Representation competency). The Framework, and an illustrative application, can be accessed https://www.unisq.edu.au/library/teaching-support/academic-frameworks

Main Findings

The focus groups revealed several interlinked student dispositions including lack of confidence, superficial learning, learner avoidance strategies, difficulties understanding expectations, and mathematics anxiety, all of which can hinder effective numeracy proficiency. Additionally, participants noted the challenges associated with the diverse range of skills of student cohorts, together with students' content challenges and negative previous experiences in their numeracy learning. These, and the institutional challenges faced by educators and study support professionals, including lack of continuity in courses and programs, time constraints and admission practices, can serve as barriers to content delivery, and to learning which results in adults who find numeracy a significant challenge. Participant responses strongly indicated that the Framework may enhance student learning and address these challenges by facilitating discussions, providing a structure to assist with assessment, course and program design, as well as the personalisation of learning.

Discussion

Transitioning to the tertiary environment can be difficult and transition spaces are premised on what has come before university entrance (a "liminal space", Lisciandro et al, 2020). It may include the building of aspiration through schooling, family expectations, and enabling programs. Tout (2020) states that 'numeracy is a critical awareness which builds bridges between mathematics and the real-world and "bridging" this liminal space requires support before and after entry (Lisciandro et al. 2020).

Traversing this liminality is best accomplished through systematic approaches to academic numeracy development (Galligan 2013b, Brady 2016). The Framework, as a multidisciplinary tool, is useful to map the assumed, target and actual numeracy skills of students informing course development and delivery and assisting educators with the design of numeracy intervention. It provides a rigorous structure to support the systematic embedding of numeracy in tertiary education curricula and learning development initiatives. In turn, this is expected to improve student numeracy outcomes.

Academic Numeracies Framework	Numeracy Levels			
	Level 1	**Level 2**	**Level 3**	**Level 4**
	Scaffolded *Students require significant scaffolding to develop numeracy skills and knowledge within a topic area.*	***Supported*** *Students require some scaffolding to develop numeracy skills and knowledge within a topic area.*	***Supervised*** *Students require some scaffolding to develop numeracy skills and knowledge within a discipline.*	***Independent*** *Students independently seek out and develop numeracy skills and knowledge within a discipline.*
Academic Competencies Communication Mathematising Representation Reasoning and argument Devising strategies Using symbolic formal and technical language & operations Using mathematical tools	**Representation** • **Formulating mathematical problems** ○ Develop a mathematical representation of a task ○ Use different representations to formulate problems • **Using mathematical concepts, procedures and reasoning** ○ Select, develop and use a range of representations when solving a problem ○ Integrate and link different representations of a problem, and translate among them • **Interpreting, applying and evaluating solutions** ○ Interpret solutions presented in different formats ○ Compare and evaluate different representations of solution			
Students ethically generate, use and interpret various representations of mathematical information relevant to a problem or situation (i.e., graphs, tables, diagrams, pictures, equations, formulae, text, etc.).	Students create, understand, use and interpret basic representations of mathematical information from limited sources.	Students create, understand, use and interpret simple representations of mathematical information from various sources.	Students create, understand, use, integrate, compare and interpret representations of mathematical information from diverse sources relevant to their disciplines.	Students independently create, understand, use, integrate, compare, and interpret complex mathematical representations relevant to their disciplines.

Figure 1. Academic Numeracies Framework: *Representation* competency. *Academic Numeracies Framework, University of Southern Queensland* (2025). https://www.unisq.edu.au/library/teaching-support/academic-frameworks

References

Australia. Department of Education, Employment and Workplace Relations. (2009). Transforming Australia's higher education system [electronic resource]. Canberra, A.C.T. : Dept. of Education, Employment and Workplace RelationsAzungah, T. (2018), "Qualitative research: deductive and inductive approaches to data analysis", Qualitative Research Journal, Vol. 18 No. 4, pp. 383-400. https://doi.org/10.1108/QRJ-D-18-00035

Azungah, T. (2018). Qualitative research: deductive and inductive approaches to data analysis. Qualitative Research Journal, 18(4), 383-400. https://doi.org/10.1108/QRJ-D-18-00035

Brady, K. (2016). Developing students' academic numeracy skills: Taking a whole-of- institution approach. Proc. Aust. Conf. on Science and Mathematics Education. The Univ. of Queensland (pp. 176-181).

Buchele, S., Feudel, F. Changes in Students' Mathematical Competencies at the Beginning of Higher Education Within the Last Decade at a German University. Int J of Sci and Math Educ 21, 2325–2347 (2023). https://doi.org/10.1007/s10763-022-10350-x

Dalim, S. F., Aris, S. R. S., Hoon, T. S., Nadzri, F. A., Deni, S. M., Yahya, N., & Si, E. M. (2023). Framework for numeracy and digital skills attributes in higher education. Research in Social Sciences and Technology, 8(3), 16–35.

Faulkner, F., Hannigan, A., & Fitzmaurice, O. (2014). The role of prior mathematical experience in predicting mathematics performance in higher education. International Journal of Mathematical Education in Science and Technology, 45(5), 648–667. https://doi.org/10.1080/0020739x.2013.868539

Gale, T., & Parker, S. (2013). Widening participation in Australian higher education. Report to the Higher Education Funding Council of England (HEFCE) and the Office for Fair Access (OFFA), England. Leicester, UK: CFE (Research and Consulting) Ltd.

Galligan, L. (2013a). Becoming Competent, Confident and Critically Aware. Adults Learning Mathematics: An International Journal, 8(1), 20–30.

Galligan, L. (2013b). A systematic approach to embedding academic numeracy at university. Higher Education Research & Development, 32(5), 734–747.

Hoogland, K & Díez-Palomar, J. (Editors). Common European Numeracy Framework Literature Overview and Review. January. P. 26.

Lisciandro, J et al In Jones, A., Olds, A., & Lisciandro, J.G. (Eds.). (2019). Transitioning Students into Higher Education: Philosophy, Pedagogy and Practice (1st ed.). Routledge. https://doi.org/10.4324/9780429279355

Mzomwe, Y., Montero, C., & Casmir, R. (2019). Investigating Students' Attitude towards Learning Mathematics. International Electronic Journal of Mathematics Vol. 14, No. 1, 207-231

Peters, L., Tompkins, M. K., Knoll, M. A. Z., Ardoin, S. P., Shoots-Reinhard, B., & Meara, A. S. (2019). Despite high objective numeracy, lower numeric confidence relates to worse financial and medical outcomes. Psychological and Cognitive Sciences, 116(39), 19386–19391.

Tout, D. (2020). Critical Connections Between Numeracy and Mathematics. Issues in The Teaching of Mathematics. ACER Australian Council for Educational Research, Research Repository. https://research.acer.edu.au/cgi/viewcontent.cgi?article=1030&context=learning_processes

University of Southern Queensland. (2025). *Academic Numeracies Framework.* https://www.unisq.edu.au/library/teaching-support/academic-frameworks