Building Mathematics Proficiency for Career Advancement: A Case Study of Adult Learners in a Pathway Program

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Abstract

This study aimed to understand the mathematical competency, confidence, attitudes, and dispositions of adult learners in a tertiary pathway program. Recognizing the challenges faced by adult learners in transitioning to higher education, especially in mathematics, we implemented a comprehensive three-part assessment. The assessment gathered data on students' educational background, mathematical competency, confidence levels, and self-reflection on their learning experiences. By understanding these factors, we sought to inform the development of targeted support initiatives to enhance student success and overall learning experience.

Key words: adult learners, pathway programs, higher education, mathematics learning, assessment, dispositions

Introduction

The transition to higher education can be challenging for adult learners, particularly when learning mathematics. Many students lack the foundational skills or confidence needed to succeed (Butcher et al, 2018), and the absence of prerequisites at some institutions can exacerbate this gap, hindering their academic progress. To better support adult learners with this transition, it is essential to understand their experiences and perspectives (Kamelita, 2018). Further complicating the transition, a potential skills gap may exist between what students perceive necessary for employment and the technical, non-technical, and behavioral skills valued by employers (Charu, 2019).

Students in Pathways Programs are usually diverse, ranging from recent high-school graduates to mature-aged learners, with varying levels of mathematics proficiency. To effectively prepare them to succeed in their tertiary study and career it is essential to consider their level of competency and dispositions entering the program. While competency tests are a common tool for assessing student skills and guiding them towards suitable pathway courses (Czaplinskia, 2019), a more comprehensive approach that incorporates additional factors is necessary to ensure student success in the program.

As educators in a Tertiary Pathway Program in a regional Australian university, we utilize a Mathematics Literacy Level test as an initial assessment of students' mathematical competency. However, recognizing the limitations of a single test and the need for a more nuanced understanding of individual needs, we developed a comprehensive three-part assessment. This assessment delves deeper, gathering information on students' background knowledge, their current mathematical competency, confidence levels, and their reflections on mathematics learning experience.

Background

Mathematics is fundamental for many professions especially in STEM (Science, Technology, Engineering and Mathematics), yet it is commonly perceived to be difficult (Li & Schoenfeld,

2019). Many adult learners returning to education after a significant break enrol in transitional programs to increase their preparedness for college-level work and confidence in their academic abilities (Hardin, 2008; Kasworm, 2003). Their lack of confidence can manifest as deeper self-perception issues and negative learning dispositions, such as a fear of change, commitment challenges, or feelings of guilt (Harris & Brooks, 1998; Kobena Osam et al., 2017).

Furthermore, student's experiences with mathematics significantly shape their attitude towards the subject (Davadas & Lay, 2017). This accumulated experience can lead to either a positive or negative outlook in future studies (Hwang & Son, 2021). Importantly, a student's attitude towards mathematics directly impacts their behaviour and thinking. Students with a positive attitude are more likely to enjoy the subject, perceive its value, and feel confident in their abilities (Mullis et al., 2020). This positive outlook translates into increased effort and dedication to studying mathematics.

This study designed and implemented an early assessment to gather information on student competency, confidence, attitudes, and dispositions towards mathematics to enhance their learning experience and inform study development initiatives.

Method

A comprehensive three-part assessment quiz was administered at the beginning of an advanced mathematics course in our pathway program. The quiz was organised as follows:

Part 1: Background Information - This section gathered data on students' educational background, including prior studies, previous courses taken within the pathway program, and future study plans. It also identified the mathematics topics they found challenging.

Part 2: Competency and Confidence - This part consisted of ten content-based questions designed to gauge students' mathematical competency. Students also rated their confidence level for each question, providing valuable insight into their self-perception of understanding.

Part 3: Student Reflection - The final section focused on student self-reflection. Students shared their study experiences, the support they felt they needed, and their overall attitude towards mathematics, including its perceived importance for their chosen career.

Main Findings

Despite their diverse academic backgrounds, most students entering this course were pursuing Science and Engineering degrees. This was expected, given that this course represents the most advanced level of mathematics offered in our pathway program. Part 1 results show that although 90% of students reported "doing well" or "managing" their studies, half of those who indicated they would "manage" ultimately failed or dropped out (Figure 1). On the other hand, most students successfully navigated the topics they considered "difficult". Part 2 responses indicate that while 60% of students reported low to moderate confidence, two-thirds of this group had adequate competency. On the other hand, about 25% of students showed low competency despite being confident with their answers (Figure 2). Even among high achievers, there was a wide range of confidence ratings. These results highlight the disparity between self-perception and actual performance. Some students have successfully developed their mathematics skills but have yet to cultivate a corresponding level of self-belief.
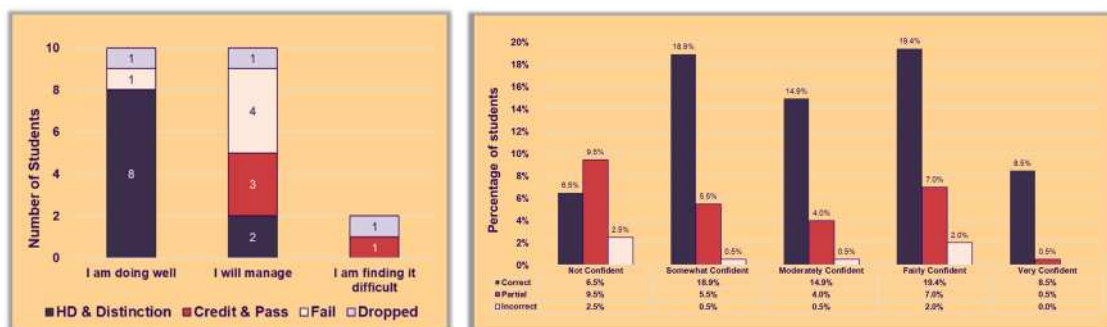
Figure 1 (left) and Figure 2 (right). Final grade compared to response (left) and Competency versus Confidence (right).

Finally in Part 3, we see that many students found learning mathematics difficult, but they recognized the relevance of the course material to their chosen careers, appreciating the use of contextualized examples and concepts. While acknowledging challenges like time constraints and balancing work with studies, students demonstrated awareness of available support options. This suggests a positive outlook on their ability to be self-directed and take responsibility for their own learning.

Discussion

Our research acknowledges the challenges faced by students lacking the assumed prior knowledge and dispositions needed for success in their chosen STEM fields. Based on their quiz responses, we added an assumed knowledge review module that emphasised the topics students found difficult and promoted its use. Additionally, we dedicated time in class to clarify concepts and address student questions. In future offering we plan to implement Peer-Assisted Study Sessions (PASS) to foster collaboration and learning from peers.

This study showed that this approach is useful to enhance the learning experience of adult learners transitioning through the Pathways program. Recognizing the diverse backgrounds of our students, it emphasizes the importance of providing a supportive learning environment. By incorporating student input ("student voice"), we can identify areas for improvement within the course and tailor support mechanisms to better address their needs for future studies.

Our reflection as educators reveals that the quiz format effectively encouraged student participation and provided an early snapshot of their focus and motivation. To further enhance the assessment, we propose adjusting the marking allocation and questions, as well as offering specific feedback to students. Building on these findings, we aim to further personalize the learning experience of students. By contextualizing the curriculum based on students' chosen career paths, we can ensure the course content directly connects to their future goals. Implementing this early assessment strategy across all STEM courses within the pathway program will allow us to tailor the learning journey for each student. We expect that this personalized approach will create a more relevant and engaging environment that fosters deeper student understanding and a positive learning experience.

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