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Psychosocial factors, level of mathematics and progression in an access programme

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This study examined the relationship between Access students' psychosocial characteristics, the level of mathematics module (advanced, intermediate or fundamental) they chose and their progression to higher education. A quantitative approach was adopted for this portion of the study, which took place over three academic years, 2017 - 2020. Questionnaires were completed by 184 students in the Access programme at Technological University Dublin. Results revealed that students with higher belief in their mathematics ability were more likely to study advanced mathematics and more likely to progress to higher education. Male students were more likely to study advanced mathematics than females and non-Irish nationals who studied advanced mathematics had higher belief in their mathematics abilities than Irish nationals but were less likely to progress than their peers.

Keywords: Access programme, psychosocial, mathematics level, self-belief, progression.

Introduction

Higher education has many societal and personal benefits but there are low participation rates for students from some sections of society, including students who are socioeconomically disadvantaged (Archer et al., 2005) and adults aged 25 – 64 years old (Eurostat, 2019). Access programmes have been established to address these inequalities by tackling the social, educational, and financial barriers that some students experience in accessing higher education (O'Reilly, 2008). To date, there has been little research on Access student progression, particularly in relation to mathematics. The goal of this study is to examine whether the psychosocial factors of motivation, personality traits, general self-efficacy (GSE) and belief about mathematics abilities (BMA) affect the level of mathematics module Access students choose and their progression to higher education.

Psychosocial Factors Affecting Progression in Higher Education

Personality traits, including extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience (McCrae & John, 1992), play a role in determining a student's educational attainment (Lenton, 2014). The personality factors of conscientiousness and openness have been found to affect students' mathematics grades (Furnham et al., 2009). Lipnevich et al. (2016) contend that conscientiousness may be beneficial for mathematics performance because it results in persistent and thorough learning, while openness has been linked to deep learning. Personality traits affect a student's likelihood to progress in higher education (Altman, 2017).

Self-efficacy affects individuals' perceptions about their abilities related to a given task (Hutchison et al., 2006) and their ability to learn (Schulze & Schulze, 2003). Schöber et al. (2018) found that self-efficacy affected mathematics achievement. According to Hall and Ponton (2005), positive

experiences with mathematics increase students' self-efficacy. Overall, research indicates that students with higher self-efficacy are more likely to progress (Erb & Drysdale, 2017).

Intrinsic and extrinsic motivation have been widely studied. Intrinsically motivated individuals do something for the inherent satisfaction they get from a behaviour, extrinsically motivated individuals engage in a behaviour for the reward they gain through external control or self-regulation (Ryan & Deci, 2000). According to Ryan and Deci, unmotivated individuals are not motivated to engage in a behaviour and feel they have no control over that behaviour. Some researchers contend that lower intrinsic motivation negatively affects student performance (Augustyniak et al., 2016) and their progression in education (Vallerand et al., 1997). There is a positive relationship between mathematics self-efficacy and students' intrinsic motivation and progression (Skaalvik et al., 2015). This study examined the relationship between psychosocial factors, Access students' mathematical experiences and their progression to undergraduate studies.

Method

Technological University Dublin (TU Dublin) offers a one-year Access programme, which provides an alternative route to higher education for mature students (students aged 23 years and older) and for young adults (students aged 22 years and under) who are socio-economically disadvantaged (Technological University Dublin, 2020). Participating students choose one mathematics module each semester at fundamental, intermediate or advanced level.

The main study, which took place over three academic years, 2017 - 2020, adopted an explanatory, sequential mixed methods approach. The ethics committee at TU Dublin provided ethical approval for the study. During the quantitative phase of the research, Access students completed a 29-item questionnaire at the start of the academic year. The questionnaire included the 28-item Academic Motivation Scale (Vallerand et al., 1992). It also included John and Srivastava's (1999) 44-item Big Five Inventory, which organizes personality traits in terms of the five dimensions of extraversion, agreeableness, conscientiousness, neuroticism, and openness to experiences. Schwarzer & Jerusalem's (1995) 10-item General Self-Efficacy Scale was included to assess students' ability to deal with unusual or difficult situations. Additionally, students rated their BMA using a five-point Likert scale, where 1 represented 'excellent' and 5 represented 'poor'.

Progression was measured based on whether students were offered a place at a higher education institution or not. The data was analysed using SPSS. Mann-Whitney U tests (U) were conducted to compare the mean ranks of data where one variable was dichotomous, and the other variable was ordinal. Chi-square tests (χ^2) were employed when both variables were dichotomous. Independence of observations was observed for all Mann-Whitney and chi-square tests.

Results

One hundred and eighty-four Access students completed questionnaires over the three years of the study. Forty-nine percent were female, 51 percent were male, 43 percent were young adults and 57 percent were mature students. Overall, 25 percent of Access students were enrolled in fundamental mathematics, 64 percent in intermediate mathematics and 11 percent in advanced mathematics. A Mann-Whitney test revealed that students who studied advanced mathematics had significantly higher mean ranks for intrinsic motivation to know than their peers ($U = 945.5$, $p = .071$).

Additionally, students who studied intermediate mathematics had higher mean ranks for extrinsic motivation external than their peers ($U = 2639.5, p = .033$). Students who studied fundamental mathematics had significantly higher mean ranks for amotivation than students who studied advanced or intermediate mathematics ($U = 1732.5, p = .002$). Young adult students had a significantly higher mean rank for extrinsic motivation than mature students ($U = 2197, p = .038$).

There was no significant difference in mean ranks for most personality traits based on the level of mathematics students studied. However, students who studied fundamental mathematics had a higher mean rank for neuroticism than their peers ($U = 1613, p = .020$). Additionally, young adults had a significantly higher mean rank for extroversion than mature students ($U = 1910, p = .001$).

Fundamental mathematics students had a significantly lower mean rank for general self-efficacy (GSE) than students who studied intermediate or advanced mathematics ($U = 3090, p = .038$). Moreover, students who studied intermediate mathematics had a significantly higher mean rank for self-efficacy than their peers ($U = 2732, p = .017$). Although male and female students did not differ in their mean ranks for GSE ($U = 3409.5, p = .826$), males were significantly more likely to study advanced mathematics than females ($\chi^2 = 4.93, df = 1, p = .026$). Additionally, non-Irish nationals had significantly higher mean ranks for GSE than Irish nationals ($U = 3999, p = .007$) and were more likely to study advanced mathematics or intermediate mathematics than Irish nationals ($\chi^2 = 3.58, df = 1, p = .059$).

Students who studied fundamental mathematics had a significantly lower mean rank for belief about mathematics their abilities (BMA) than those studying intermediate or advanced mathematics ($U = 3562, p = .014$), and students studying advanced mathematics had a higher mean rank for BMA than their peers ($U = 97.6, p < .001$). Additionally, non-Irish nationals had a significantly higher mean rank for BMA than their Irish peers ($U = 4916.5, p < .001$). The findings related to psychosocial factors are outlined in Table 1.

Table 1: A Comparison of Mann Whitney Mean Ranks for Psychosocial Factors by Mathematics Level, Age and Nationality

	Mann Whitney Mean Ranks				
	Mathematics Level			Age	Nationality
	Fundamental	Intermediate	Advanced	Young Adult	Non-Irish National
Motivation					
Intrinsic motivation to Know			Higher		
Extrinsic Motivation External		Higher			
Extrinsic Motivation Total				Higher	
Amotivation	Higher				

Personality			
Neuroticism	Higher		
Extroversion			Higher
Self-Efficacy	Lower	Higher	Higher
BMA	Lower		Higher

Mathematics and Progression

Overall, 85% of students who studied fundamental mathematics, 84% of those who studied intermediate mathematics and 89% of students who studied advanced mathematics progressed to higher education. Statistically, students studying intermediate mathematics were more likely to progress ($\chi^2 = 7.57$, $df = 1$, $p = .006$) than those studying fundamental or advanced mathematics.

Moreover, mature students studying intermediate mathematics were more likely to progress than their young adult peers ($\chi^2 = 8.39$, $df = 1$, $p = .004$), but non-Irish nationals who studied advanced mathematics had lower progression rates than Irish nationals ($\chi^2 = 2.92$, $df = 1$, $p = .087$).

There was no statistically significant difference in progression based on students' mean ranks for intrinsic motivation total ($U = 2647.5$, $p = .552$) or extrinsic motivation total ($U = 2363$, $p = .969$). Moreover, students' mean ranks for amotivation were not significantly different depending on whether they progressed or not ($U = 3076.5$, $p = .329$).

Overall, there was no significant difference in mean ranks for personality traits based on whether Access students progressed or not – extraversion ($U = 2521$, $p = .909$), agreeableness ($U = 2245$, $p = .872$), conscientiousness ($U = 1978$, $p = .140$), neuroticism ($U = 2681$, $p = .856$) or openness ($U = 2149$, $p = .114$).

Additionally, there was no statistically significant difference in progression based on Access students' mean rank for GSE ($U = 2815.5$, $p = .425$). However, students who progressed had significantly higher mean ranks for BMA than those who did not progress ($U = 2807.5$, $p = .022$).

Discussion

This study aimed to determine whether there was a relationship between the psychosocial factors of motivation, personality traits, GSE and BMA and the level of mathematics Access students study as well as their progression to higher education. The findings revealed a relationship between all four psychosocial factors and the level of mathematics module Access students studied.

Access students who studied fundamental mathematics had significantly higher mean ranks for amotivation and neuroticism and significantly lower mean ranks for GSE and BMA than their peers. Prior performance has been found to be a predictor of students' self-efficacy in mathematics (Lopez and Lent, 1992), while students with higher self-belief in their ability to succeed in higher education mathematics classes have better mathematical skills (Hall and Panton, 2005). Access students with lower GSE and BMA may have weaker mathematics skills or their past performance in mathematics

may have affected their BMA as indicated by Lopez and Lent (1992). Additionally, research indicates that neuroticism creates negative emotions, results in failure to progress and results in a negative reaction to the fear of failure (Barthelemy & Lounsbury, 2009). Fundamental mathematics students' lower mean ranks for GSE and BMA, in conjunction with their higher neuroticism scores, may have resulted in amotivation, as individuals who are not motivated to engage in a behaviour, may feel they have no control over that behaviour (Ryan & Deci, 2000).

Alternatively, advanced mathematics students had higher mean ranks for GSE, BMA and intrinsic motivation to know, which is regulated by the pleasure of learning something. Mueller et al. (2011) contended that intrinsic motivation increases self-efficacy and results in the development of more favourable tendencies towards learning mathematics, which may have influenced students' decision to choose the advanced mathematics module in the Access programme.

Although male and female student had similar mean ranks for GSE and BMA, females were less likely to study advanced mathematics. This may be because mathematics is seen as masculine (Mendick, 2005) and because males are more likely to choose mathematics intensive careers (Law, 2018). Access students choose the level of their mathematics module based on the higher education course they wish to pursue, and male Access students were more likely to aspire to study mathematics intensive fields such as engineering, physics and computer science than female Access students.

Access students with higher BMA scores had higher progression rates than their peers. Students generally have a good awareness of their academic abilities (Mattern & Shaw, 2010; Reason, 2003). Mattern and Shaw (2010) also found that students with higher BMA had higher GPAs and were more likely to progress from first to second year of higher education.

Although there were no significant differences in progression in relation to personality traits, motivation or GSE, mature students studying intermediate mathematics had higher progression rates than young adults. Young adult students had higher mean rank scores for extrinsic motivation than mature students. Research indicates that students thrive in an educational setting where they are more intrinsically motivated (Ryan & Deci, 2000), which may explain the lower progression rates for young adults studying intermediate mathematics. Moreover, young adult Access students had significantly higher extroversion scores than mature students, and extroversion is negatively related to educational attainment (van Eijck & DeGraaf, 2004).

Non-Irish nationals studying advanced mathematics were significantly less likely to progress than their peers although they had higher mean ranks for BMA and GSE. Non-Irish nationals, who were non-native English speakers, may have failed to progress because they experienced difficulties in modules that required advanced English language skills. Higher education students' academic achievement can be affected by English competency (Harris & Ní Chonaill, 2016).

Limitations and Recommendations

The sample size was relatively small, although it represented 67 percent of participants in the Access programme over the three years of the study. Additionally, the General Self-efficacy Scale was employed in the questionnaire, but a college self-efficacy scale may have been more pertinent. Asking participants to complete the AMS and the GSE at the end of the Access programme as well as at the

start would have indicated whether Access students' self-efficacy, BMA or intrinsic motivation increased during their studies.

Future research should examine more closely why Access students choose the level of mathematics modules that they do, their previous mathematics performance and the reasons why non-Irish nationals studying advanced mathematics are less likely to progress than their Irish peers. This data would help to determine whether the relationships identified in the current study are causal relationships or whether they are affected by other confounding factors.

Conclusion

Although there is no difference in progression, overall, depending on the psychosocial factors of motivation, personality and GSE, these factors may affect the level of mathematics modules that students choose to study. This in turn may affect the higher education courses students aspire to, as mathematics intensive courses may require advanced mathematics. Therefore, it is important that students are made aware of the opportunities that advanced mathematics can afford them.

Given that students with higher BMA had higher progression rates, overall, Access students should be encouraged to improve their BMA and their GSE by following Heslin and Kelhe's (2006) recommendations of engaging students in enactive self-mastery, role-modelling and verbal persuasion.

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