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In search of the key factors that influence student success at university

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Abstract: *This paper describes the results of the first stage of a longitudinal research project being undertaken at the University of Southern Queensland (USQ) to identify the key predictors of academic success. By identifying the individual and sociocultural factors that influence how individual students perform, educators are in a better position to make changes to the teaching and learning environments so that future commencing students can achieve a smoother and more successful transition to university. The research team used a battery of tests to gather a wide variety of data about students in the on-campus offer of a first year engineering course. The data was analysed to gain an understanding of the diversity of the students in the cohort and to identify the significant factors that influenced their success in their first year of study at USQ. The results indicated that Queensland Tertiary admission centre rank significantly predicted academic success and, interestingly, the Extroversion personality trait also proved to be important. The implications of these findings are discussed.*

Keywords: *transition, learning profiles, academic achievement*

Introduction

All students entering university for the first time will go through a transition phase that will vary from student to student. For some, that experience will be exciting. These students will tackle the challenges thrown up by new learning and social experiences. For others, the experience will be far less enjoyable and may even be traumatic, leading to an early end to their tertiary education. Others will leave university because they come to the realisation that university is not for them at that point in time. Thus, for many students the transition experience can have a profound effect on their success at university.

It is therefore not surprising that considerable research has been undertaken in Australian universities over recent years to identify the factors that influence success at university and measures that can be implemented to smooth the transition experience for students (McKenzie, Gow, & Schweitzer; 2004; McKenzie & Schweitzer, 2001). For example, research at Edith Cowan University identified a number of characteristics that may place students “at risk”, including:

- (a) commencing non-school leaver students;
- (b) distance students
- (c) students from isolated regions, particularly Aboriginal students; and
- (d) students from a low socioeconomic background (Attrition Working Party, 1998, as cited in Walstab, Golding, Teese, Charlton, & Polesel, 2001). In general, the literature supports the notion that a higher proportion of students leave university because of “adjustment or environmental factors rather than intellectual difficulties” (Pitkethly & Prosser, 2001, p. 186).

Today’s commencing cohorts are very different from those of yesteryear. The contemporary student cohort is likely to be far more diverse on a range of measures, including age, culture, educational experience, intellectual ability, work experience, and socioeconomic status. McInnis, James, and Hartley (2000) found that a large proportion of first-year on-campus students in Australia were not fully prepared for tertiary education, were uncertain about what was expected of them, and were not motivated to achieve in their studies.

Therefore, tertiary educators, particularly those teaching commencing students, need to take a fresh look at the learning environment they provide and how it caters for vast differences in backgrounds, abilities, skills, and learning styles (McKenzie & Schweitzer, 2001), and how it impacts on the quality of learning (Entwistle & Smith, 2002). They need a deeper understanding of the factors that influence learning at the faculty or school level (Pitkethly & Prosser, 2001) to avoid making a superficial response to student diversity (Burke Guild, 2001).

Three factors are frequently mentioned in the literature as being relevant to academic success: previous academic achievement, self-efficacy, and preferred learning styles.

In general, students who enter university with higher entry scores also achieve higher academic results at university (McKenzie & Schweitzer, 2001). In contrast, however, the literature has provided variable results regarding to extent to which students’ self-efficacy beliefs influence academic achievement. For example, Pajares (1996) argued that self-efficacy plays a key role, determining the amount of effort students will apply to their studies and the length of time they will persevere with their program. In contrast, Cassidy and Eachus (2000) and Zeegers (2004) argued that academic self-efficacy is not directly predictive of academic achievement. However, Zeegers noted that self-efficacy is related to the adoption of deep and strategic learning approaches. Similarly, Entwistle and Smith (2002) found that the students’ approach to learning (i.e., deep or surface) depended on their intention, motives, and perceptions of the task demands.

Smith and Dalton (2005) and Sarasin (1999) emphasised the need for both teachers and students to understand their individual learning styles and preferences. Such self-knowledge will in time empower students to become self-directed and autonomous learners (Sarasin). Other researchers have suggested that teachers who are aware of their own learning preferences become more sensitive to the approaches and styles used by others (ANTA, 2002; Banks, Cookson, Gay, & Hawley, 2001; as cited in Smith & Dalton) and better able to adjust teaching to suit diverse student styles (Sternberg & Zhang, 2001, as cited in Smith & Dalton).

Therefore, although relevant, discussion of the topic of learning styles is beyond the scope of this paper. An initial analysis of the data showed that none of the diverse learning style preferences reported by students in this cohort correlated with academic achievement. This finding supports the results of a similar study by Busato, Prins, Elshout, and Hamaker (2000) in the Netherlands. Busato et al. examined the intellectual ability, learning styles, personality, achievement motivation, and academic success of

psychology students over a three-year period. They found no relationship between learning preferences and academic success.

Venter (2003) suggested that teachers must respond to student diversity so they can enable each student to become a confident, self-directed, and independent learner. An inclusive learning environment that caters for the increasing diversity among commencing student cohorts may make the difference between success and failure. The challenge, then, is how to achieve that goal, particularly when more than one mode of delivery is utilised, and where many students enter a program with advanced standing.

The first stage of the process is to understand the characteristics of the students in the commencing cohort. University or even program-specific data are required because the profile of “at risk” students varies from institution to institution, and even between the programs offered by a single institution (Pitkethly & Prosser, 2001; Walstab et al., 2001). This is due to the diversity of the students within each commencing cohort, and because of the variation in the skill sets required to be successful in each of the programs.

The Student Learning Profiles Project

A longitudinal research project is currently underway at USQ aimed at identifying the key factors that impact on student learning so that adjustments to the teaching and learning environments can be made to ensure a smooth and successful transition to university for all students.

A battery of tests was developed to create a “learning profile” for each student by identifying students’ learning preferences, cognitive abilities (e.g., general reasoning, verbal, and spatial abilities), and major personality traits. A common taxonomy classifies personality traits in terms of the “Big Five” factors (Costa & McCrae, 1992): Openness to Experience (O), Conscientiousness (C), Extroversion (E), Agreeableness (A), and Neuroticism (N). All participants are provided with individual feedback on their “learning profile”.

The project has been designed to assist educators to: (a) adopt appropriate entry requirements for programs, (b) develop relevant curriculum; and (c) employ appropriate teaching methods to improve students’ transition. The results of the project will therefore enable educators to better identify those individual differences factors that influence academic achievement. This will ensure that those students who are most at risk of failing or withdrawing from their program are more easily identified, and where appropriate, provided with career counselling, mentoring, or targeted skills enhancement programs.

In stage one of the project, the test battery was offered to two groups of commencing on-campus students at USQ: (a) Those enrolled in one of the many undergraduate programs offered by the Faculty of Engineering and Surveying; and (b) those in the psychology major in the Bachelor of Science program which is offered by the Faculty of Sciences. These two cohorts provide contrasting samples, particularly in relation to gender and educational background. Engineering is a male dominated profession and psychology has over recent years become a very female dominated profession. This paper will report on data obtained from the first stage of this testing process, using only the sample of first-year engineering students studying on-campus at USQ.

In the longer term, the research project involves tracking the academic performance of these students through until they complete their degrees or leave the university. The test battery will also be available via the internet to facilitate a more efficient data collection process and to make the project available to distance students. Teaching staff are encouraged to participate in the testing process so that their learning profiles can be compared with those of their students.

Student diversity within the Faculty of Engineering and Surveying

The Faculty of Engineering and Surveying at USQ offers a range of highly articulated undergraduate programs in engineering and in spatial science. All of the programs are offered in the on-campus and distance education modes, with 75% of the students studying off-campus.

The commencing student cohort typically exhibits great diversity in a range of characteristics including age, educational background, work experience, mathematical skills, ethnicity, culture, home locality, and social status. With many of these characteristics there are distinct differences between the on-campus and distance student cohorts. Figure 1 highlights the age profiles of the two cohorts. As shown in this figure, the large majority of commencing students are at least 20 and will have had at least one year of work experience prior to commencing their studies. Just over 5% of the commencing distance students are under 20 years of age, and only 55% of the commencing on-campus students are under 20. This indicates that it is likely that less than 50% of the on-campus cohort have come directly from high school. The diversity within the commencing cohort in the Faculty's undergraduate programs demands the development of an appropriate curriculum to facilitate transition into tertiary studies and thus improve student retention.

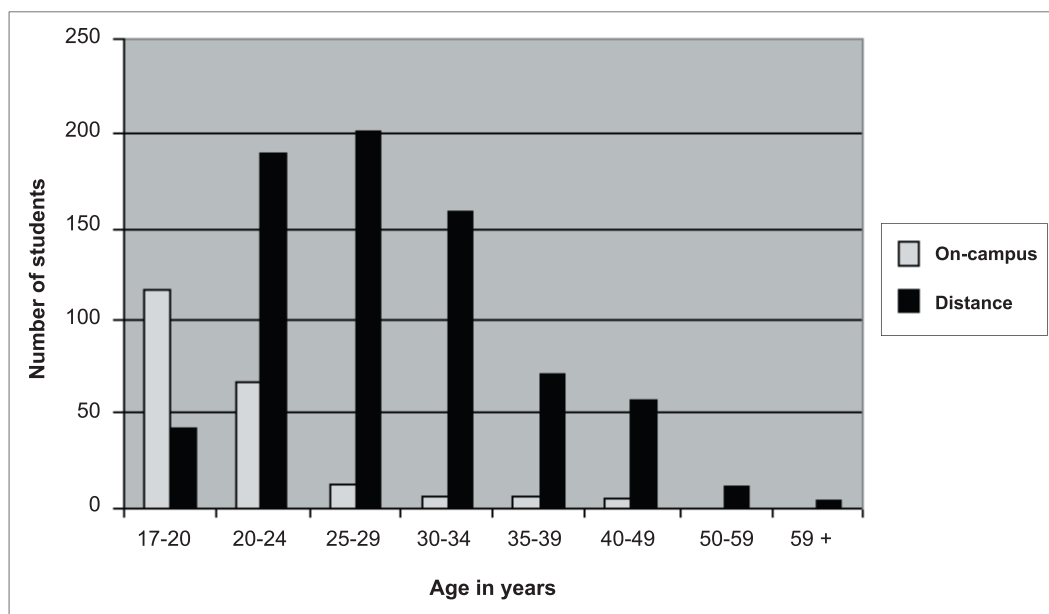


Figure 1. The age distribution of commencing students by study mode.

Method

Participants

A total of 132 commencing on-campus students (17 females and 115 males) participated in the study. Complete data were obtained from 66 students (13 females and 53 males), with a mean age of 20.15 years ($SD = 4.99$). The mean age of the females was 18.15 years ($SD = 2.51$), and the males had a mean age of 21.96 years ($SD = 6.51$). Most had not previously studied engineering or surveying. All but five students spoke English as their first language, with six other languages spoken across the sample.

Eight students in the sample did university preparatory studies prior to commencing their engineering degrees. Four students cancelled their enrolment during or at the end of their first year of study in 2004 and another four students remained enrolled in their program but did not study in Semester 2. Six students chose to transfer to another degree at the end of their first year of study. Interestingly, five of these students were female. This is of concern for the Faculty as the female participation rate in engineering programs is already less than 12%.

Test battery

The following measures were included in the test battery to better establish those individual differences factors central to academic success.

Cognitive ability tests

General reasoning, verbal, and spatial abilities are cognitive abilities often shown to predict academic achievement (Rothstein & Paunonen, 1994). All three cognitive abilities are clearly relevant to success in the engineering profession, especially spatial ability (Strong & Smith, 2002).

Each of the following reference tests were from the Ekstrom, French, Harman, and Dermen (1976) kit of factor-referenced cognitive tests, except where otherwise indicated. The dependent variable for each reference test was the total number correct.

General reasoning ability (the ability to reason, form concepts, and problem solve with novel information) was measured by the following three tests: (a) Letter Series (Thurstone & Thurstone, 1965); (b) Number Series (Thurstone & Thurstone, 1965); and (c) Matrices test (Cattell & Cattell, 1965). Verbal ability (the ability to process information presented as words) was measured by summing performance across three tests: (a) Scrambled Words; (b) Hidden Words, and (c) Incomplete Words.

A total of nine marker tests were included to measure three major spatial factors: Spatial Relations, Visualisation, and Spatial Scanning. The Spatial Relations factor reflects the ability to perceive an object from different positions. Spatial Relations ability was computed by summing performance on the following tests: (a) Card Rotations, (b) Cube Comparisons; and (c) Spatial Relations (Thurstone & Thurstone, 1965). The Visualisation factor reflects the ability to apprehend a spatial form and rotate it in two or three dimensions before matching it with another spatial form. Visualisation ability was computed by summing performance on each of the following tests: (a) Paper Form Board; (b) Paper Folding, and (c) Surface Development. The Spatial Scanning factor reflects the speed with which you can mentally scan a map or object and find a path or connection between two points. Spatial Scanning ability was computed by three mental scanning tests: (a) Maze Tracing Speed, (b) Choosing a Path; and (c) Map Planning.

Self-report survey

The self-report survey asked for demographic information on variables including gender, age, language, nation of origin, field of study, and experience. Additionally, data on student Queensland Tertiary Admission Centre rank and year 12 subject results were obtained. Questionnaires measuring the five major traits of personality (OCEAN), Self-efficacy, Proactive Attitude, and Proactive Coping, each using a 5-point Likert scale, were also included. These individual differences variables were each included in the battery because they potentially play an important role in helping students manage the challenges of first year studies. Self-report measures of preferred learning styles were also included in the survey (unreported).

The Big Five factors of personality were measured using the short version of the International Personality Item Pool questionnaire (Goldberg, 1999). Ten items were used to compute a total score for each major personality factor, including: Extroversion - a person's interest in interactions with others and levels of sociability; Agreeableness - cooperation versus competition; Conscientiousness – self-control and need for achievement; Neuroticism - emotional stability; and Openness to Experience - preference for familiar versus novel experience (Costa & McCrae, 1992).

Self-efficacy reflects a student's optimistic belief in their ability to cope with stress in a variety of challenging situations (Bandura, 1977; Schwarzer, 1993) and was measured using the revised 10-item General Self Efficacy scale (Schwarzer & Jerusalem, 2000). Proactive Attitude reflects a student's belief in various facets such as resourcefulness, responsibility, values and vision and was measured using the 8-item Proactive Attitude scale (Schwarzer, 1999). Proactive Coping reflects a student's ability to commit to, and engage in, an autonomous and self-directed setting and was measured using the 14-item Proactive Coping scale (Greenglass, Schwarzer, & Taubert, 1999).

Performance outcomes

The grade point averages (GPA) the students achieved for both their first semester (GPAS1) and their first year of study (GPAY1) were used as measures of their academic success. Data on the grades the students achieved in their first and second semester courses were also obtained.

Procedure

The total testing time was about 2.5 to 3 hours, broken into two, 1-hour test sessions and a take-home self-report survey. The first session involved the timed general reasoning and verbal ability tests and the first half of the spatial ability tests. The second session included the second half of the spatial ability tests. A maximum of 25 people were present in either test session as students completed these tests during weekly tutorials. At the end of the second test session, students were each given the self-report survey to complete in their own time. They were required to return the completed survey in a sealed envelope within one week. Testing was carried out over a 4-week period. Students who completed the full battery of tests received feedback on their verbal and spatial ability levels, personality traits, and preferred learning styles.

Results

The following analyses examine the nature of the relationship between cognitive abilities, personality traits, self-efficacy and academic achievement.

Correlations

Table 1 presents the test variables correlated against the grade point averages (GPAS1 and GPAY1). Queensland Tertiary admission centre rank is the main factor used to allocate university places once other entry requirements have been satisfied. It is a measure of previous academic achievement and, as expected, it showed a strong positive correlation with both grade point average variables.

The results in Table 1 show that both verbal and spatial abilities were related to success in students' first year of tertiary study. While all spatial abilities were to some extent associated with academic achievement, Spatial Relations ability, in particular, seems especially relevant to success in first year of engineering studies. Further analysis will establish whether these abilities are particularly relevant to success in the graphics and design courses. If these correlation trends are replicated in future testing they may prove to be the critical predictors of student success in their overall program.

Of the Big Five personality measures, the on-campus cohort scored highest on the Agreeableness personality trait ($M = 38.13$, $SD = 5.48$) – being sympathetic, trusting, co-operative, modest and straightforward – although this trait was not significantly related to overall academic success. Interestingly, although the student sample scored lowest on the Extroversion personality trait ($M = 30.97$, $SD = 7.77$), this personality variable correlated most highly with academic success for both Semester 1 and Year 1.

Self-efficacy and Proactive Attitude, which together reflect self-confidence, were both shown to be moderately related to academic success. Self-efficacy helps empower students to manage their learning environment, regardless of the course of study.

Variables	Correlation Matrix	
	GPAS1	GPAY1
Cognitive Abilities		
General Reasoning	.19*	.23*
Verbal	.27*	.34**
Spatial Relations	.32**	.36**
Visualisation	.25*	.21
Spatial Scanning	.30**	.27*
Personality Traits		
Extroversion	.32**	.35**
Agreeableness	.25	.24
Conscientiousness	.18	.24
Emotional Stability	.24	.20
Openness to Experience	-.03	-.11
Self-Efficacy	.33*	.24
Proactive Attitude	.28*	.27*
Proactive Coping	.21	.20
Other Indicator Variables		
Queensland Tertiary admission centre Rank	.64**	.87**

Note. GPAS1 is the final grade point average for Semester 1, 2004; GPAY1 is the final grade point average for end of first year of study; Queensland Tertiary admission centre rank is calculated from the year 12 subjects by the Queensland Tertiary Admission Centre.

* $p < .05$. ** $p < .01$.

Table 1: Correlation Matrix: Cognitive Abilities, Personality Measures, Queensland Tertiary admission centre Rank, and grade point average

Regression analysis

An overall regression analysis was not appropriate due to the small sample size. Given that Queensland Tertiary admission centre rank is strongly correlated with GPAY1, this variable was controlled for to better establish the contribution of the remaining variables in the battery. In order to establish the relative predictive value of the personality traits in the test battery, Queensland Tertiary admission centre rank was regressed first onto the GPAY1 variable, and then onto the Big Five Factors. Queensland Tertiary admission centre rank was controlled for by entering it at step one of the regression. Step one of the analysis revealed that Queensland Tertiary admission centre rank was a significant predictor ($\beta = .48$, $t = 2.92$, $p < .01$) of 23% of GPAY1 ($F(1,46) = 21.31$, $p < .01$). When the five personality factors were entered at step two, R^2 increased to .52 ($F(6,41) = 4.03$, $p < .01$). Extroversion was found to be the only personality trait that significantly predicted academic achievement ($\beta = .40$, $t = 2.33$, $p < .05$). The results of the hierarchical regression analysis are summarised in Table 2.

Dependent Variable	Independent Variables	β	sr2
GPAY1 – Step 1	Queensland Tertiary admission centre Rank	.48	.23**
GPAY1 – Step 2	Extroversion	.40	.18**
	Agreeableness	.13	.01
	Conscientiousness	.13	.01
	Neuroticism	-.13	.01
	Openness to Experience	-.26	.06
	Step 1	$R^2 = .23$	
	Adjusted	$R^2 = .20$	
	Step 2	$R^2 = .51$	
	Adjusted	$R^2 = .39$	

Note. GPAY1 is the final grade point average for end of first year of study; Queensland Tertiary admission centre rank is calculated from the year 12 subject by the Queensland Tertiary Admission Centre.

** $p < .01$.

Table 2: Hierarchical Regression of GPAY1 on Queensland Tertiary admission centre Rank and Personality Variables

Separate hierarchical-step regression analyses were conducted for both the cognitive ability variables and for the self-efficacy variables. No variables in either set made a significant contribution to GPAY1 beyond the Queensland Tertiary admission centre rank variable entered at step one.

Discussion and implications

The implications of the key findings that emerged from stage 1 testing are discussed in the following sections.

Previous academic achievement

The results concur with those of McKenzie and Schweitzer (2001) who found that previous academic performance was the most significant predictor of university performance for first-year Australian university students. Similar findings are reported for other countries (e.g., Busato et al., 2000). This data should, however, be analysed in detail to determine if the Faculty should adjust the entry requirements for its programs (McKenzie & Schweitzer, 2001).

Self-efficacy

As expected, self-efficacy and proactive attitude were both related to academic success, although neither measure directly predicted grade point average. Self-confidence helps empower students to manage their learning environment, regardless of the course of study. Students high in these self-regulatory traits also do well in courses where they must work in teams, as they need to collaborate with others to complete the task. It will be interesting to establish the importance of these traits to students learning via distance education. Research is currently underway to provide answers to these questions.

Personality

The on-campus student sample scored highest on the Agreeableness personality trait, although Extroverted students were more likely to be successful. This finding is in contrast to previous research that found Introverted and Agreeable students more likely to be successful in their studies (McKenzie, Gow, & Schweitzer, 2004). This finding may be due to changes in the curriculum brought about by an increasing emphasis on generic attributes and capabilities, such as communication skills and teamwork, by both the University and Engineers Australia, the accrediting institution. A greater emphasis is now placed on these skills in the first-year curriculum and assessment. For example, two of the first year courses involve a substantial amount of team work and a considerable component of the assessment is based on team processes and outcomes. Additionally, the students must report verbally on the results of their work in a number of courses. It is therefore understandable that Extroverted students, who feel confident and comfortable consulting and collaborating with others, socialising, and working in teams, are more likely to be successful in assessments measuring these capabilities than their more Introverted peers.

The implication is that the curriculum change may now be rewarding Extroverted students in their assessment practices. If the current findings are replicated in further testing of on-campus and distance students, then the Faculty will need to consider moving team-based assessment from first-semester to second-semester. This will provide students with more time to become familiar with the learning and teaching environment and also facilitate a smoother transition to university.

Identifying the factors that influence academic performance enables teachers to identify the “at risk” students. It is then possible to target interventions and provide appropriate support services for these students (Rosenfeld & Rosenfeld, 2003). This should include the provision of career counselling services for those who wish to depart the university. This strategy is aligned with the first of Tinto’s (1987) six principles to enhance first year student success at university: “Students enter with, or have the opportunity to acquire, the skills needed for academic success” (p. 140).

Conclusion

The challenge for teachers in today's tertiary education sector is delivering a learning environment that is inclusive and caters for the increasing diversity among student populations. A one-size-fits-all approach no longer makes the grade. But acknowledging diversity is one thing – achieving inclusiveness is another. To make effective adjustments to their methodologies, teachers need to better understand exactly what it is about individual students that can make the difference between success and failure in their academic performance.

The results from stage one have enabled the project team to identify the key variables influencing academic success during a student's first year of tertiary study at USQ. The continuing students in this cohort will be tracked until their departure from the university, which will provide valuable longitudinal data for this group. The current data has also enabled the test battery to be refined, so that it focuses on the key variables and decreases the total time for testing. The web delivery of the battery will also improve the efficiency of the testing process as it will automate data collection and enable distance students to participate.

The initial results are being used to inform a review of the engineering programs at USQ. In stage two of the project, an attempt will be made to recruit all commencing students, regardless of study mode and level of entry. Given that 75% of the Faculty's students study via the distance mode, it is vital that data from this cohort be included in the study because other factors, including sociocultural factors, may prove to be significant to academic success for these students.

Once the data from stage two testing is analysed a reliable decision can be made by the Faculty review team on the first year courses and those to be studied in Semester 1. At that time the Faculty will investigate the need for, and the feasibility of, developing and implementing, appropriate interventionist strategies.

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