Transitional Issues Affecting the First Year Engineering Experience

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CONTEXT
Transitioning into higher education engineering degrees can be difficult for students, resulting in disengagement, failing, and/or dropping out. Universities provide many support services to students on and off campus, yet despite this, many engineering students either do not know about the services available, do not know how to access these services, or leave it too late to receive help. This can be especially hard to navigate when students transition into engineering courses from different pathway courses, entering into later years. Students can struggle because of external inputs, such as cultural background, commitments and responsibilities and academic skill levels, internal issues such as self-management, motivation and learning mindset, and the environment in which transition occurs, such as the relationships with people and the course. The student awareness of available support services throughout their transition is crucial, to ensure every student receives the help and assistance that they need to help them achieve.

PURPOSE
The purpose of this research is to explore and describe the issues that students face when transitioning into engineering courses, from the perspective of key support stakeholders.

APPROACH
Key support stakeholders were first identified as people critical in supporting student transition, including student advisors, directors of academic support units, faculty academics, course advisors, first year unit lecturers and student volunteers. Semi structured interviews were conducted with these stakeholders to identify the transitional issues. This investigated the role of the stakeholder in assisting student transition, the common issues that they saw students experiencing, and whether any issues were specific to engineering. The data was then analysed thematically to identify the main transitional issues.

RESULTS
Themes emerged from the data were grouped into three distinct influences upon students and their ability to transition. 1) external inputs, including cultural background, academic skill set and external responsibilities, 2) internal characteristics, including learning mindset, self-management and motivation, and 3) the environment in which transition occurs, including student-student relationships, student-teacher relationships and engagement with course. These groupings allow support to be directed either to groups of students, individual students, or to the university environment.

CONCLUSIONS
Whilst students are all different, their abilities to transition into first engineering can be predicted based on a set of factors, some external, and some the student might not be aware of themselves. The external factors can be known by the university in advance allowing for additional support measures to be tailored to particular student demographics.

KEYWORDS
Engineering, Transition, First year.

Introduction

Transitioning into higher education engineering degrees can be difficult for students, resulting in disengagement, failing, and/or dropping out. This can be due to numerous reasons, which universities try to address with support services. Universities provide many support services to students on and off campus, yet despite this, many engineering students either do not know about the services, do not know how to access the service or leave it too late to receive help. This can be especially hard to navigate when students transition into engineering courses from different pathways. Class sizes and curriculum are too big for lecturers to notice or be responsible for personally assisting struggling students who do not ask for help (Cuthbert and MacGillivray 2003), leaving students who are struggling to transition to fall through the cracks, ultimately failing numerous subjects and increasing their HECs debt, dropping out of university or being forced to. Universities have tried to combat this with awareness programs about available services (Cahir, Huber, Handal, Dutch, & Nixon, 2012), strongly pushed 'optional' sessions for students to attend (Larmar and Ingamells 2010), blanket solutions (Allen and Workman 1989), or additional programs and courses that students can be enrolled into (Hartigan and Brown 2010). These tactics can be beneficial for a student who hasn't yet fallen too far behind, without many existing responsibilities, or commitments. Students do not fit a specific mould however; there are those who have families to support, financial situations which require long work hours or health issues that make attendance difficult, and many other individual situations which make transitioning complex, and therefore experience different transitional issues. These students are forgotten and ignored due to the difficulty of personalising support and informing students when the information would be most pertinent. Universities are failing to be accessible and to not discriminate.

A solution needs to be found to stop students being left behind. This project aims to identify key metrics associated with transitioning issues for engineering students, and therefore address this gap in a university's ability to properly assist students.

Literature Review

Improving student transition has been a large focus for universities globally, with each institution determining different key issues and therefore best approach solutions.

The University of Southern Queensland has previously conducted research into traits of students, with the aim of determining how critical certain attributes were to a student's success (Dowling and Burton 2005). This included their personality, background, academic marks, any at risk statuses and followed them throughout their studies. The main finding was that students, who did not come directly from secondary school or a tertiary preparation program, were more likely to struggle academically in their first year of study. This suggests that the transition for non-school leavers is most difficult scholastically and more support measures should be communicated to assist.

The University of Wollongong have found knowledge gaps for students transitioning from PAVE (pathways and vocational education) to university education (Millman 2013). When students are granted advanced standing, they can skip first year, straight into second year subjects, resulting in greater expectations and the basic skill sets are not explicitly explained, taught or able to be practised. Watson (2008), notes that students from PAVE pathways tend to lack critical thinking, abstraction, theoretical understanding on a deeper level, and general literacy capabilities expected in a university setting. Furthermore, it is understood by university academics that students require and should already hold the ability to study independently, autonomously and be self-motivated to succeed, resulting in a lack of understanding between academics and students with PAVE advanced standing. These differences in expectations require students to attain missing skills, meet the deadlines and

the greater workload. Transitional issues for PAVE students consequently centre on new expectations, literacy ability and autonomous study and learning habits.

Queensland University of Technology realised the difficulty engineering students experience when they have missed core concepts in their earlier mathematical education, or have taken a lower level mathematics subject during high school (Cuthbert and MacGillivray 2003). Gaps in student understanding for mathematics are a large hindrance in any engineering course, because expected knowledge cannot be taught during lectures or tutorials, supporting the need for external support within a university. QUT's introduction of a maths help centre and extensive advertising of the centre during a first year engineering mathematics class reduced the failure rate within second year engineering math subjects, suggesting that support services work, but need awareness, which can be quite effective when paired with a related subject.

Yorke and Longden (2008) found seven factors for early disengagement and dropping out. Two of these were outside of teaching and administration issues: financial and social. Without a student's external environment being suitable, engagement and success at university becomes much more difficult. Additionally, contact with academic staff has become a more significant factor since the initial research conducted in 1997, suggesting that student-staff relationships have a large role in student retention. This research showed little difference in expectations of experience across demographics, however highlights the impact that university culture and community can have, as well as financial stability. Leading to the suggestion that students from low socio-economic backgrounds, are more likely to be at risk through disengagement, due to financial issues, and therefore lessened social time from greater work hours.

An attrition working party at Edith Cowan University identified non-school leavers, distance education students, Aboriginal and Torres Strait islanders, as well as students from isolated regions and low socio-economic backgrounds, as being most likely to be at risk throughout a university course (Attrition Working Party 1998). This can be explained by connectedness, which when lessened; a student's ability to be resilient is reduced (McGraw 2005). This occurs during periods of transition, such as the one to university, a change in environment, or distance from family, friends, community and religion. If students do not feel, or do not have strong support networks when they make the transition to university, they are going to suffer academically and emotionally. Academic ability greatly determines the retention of first year students. Rickinson and Rutherford 1995, support the theory of connectedness, identifying that emotional preparedness and inclusion on campus are crucial to university success. Universities have clubs, societies and welcome events to make the shift easier, however communication about these services is dependent on university, manpower, time and budget for each event or club.

International students can struggle with their transition, to not only the university and the new expectations, but also the transition to the new culture (Schwarzer 1994).Australia is one of the top five international study destinations (Australian Government 2015),but despite the large proportion of international students, their transitional issues are still unique, and mostly unaddressed. Adjustments culturally, and psychologically, such as home sickness, isolation and depression (Sandhu 1994), as well as English proficiency issues, add challenges to the new environment. Furthermore, a study showed that Taiwanese students are less likely to ask questions in lectures (Sandnes 2006), which can be associated with their higher respect for teachers, resulting in not addressing gaps in their knowledge (Jian 2010). These transitional issues are unique to international students, and require greater support if international students are going to continue to choose to study in Australia.

Computer skills were seen as sometimes lacking in mature age students and some international students (Smith 2009). Whilst an expected skill, it was not present in all students. Similarly, mature age students face other disadvantages, both in terms of expected skill set, and external responsibilities. These can include employment, parenting, financial

issues and other life stresses, and these often conflict with the notion of becoming a student, especially when required to continue to fulfil those roles (Seary 2011). This can lead to the feeling of bombardment. Additionally, the gap away from formal learning can cause difficulties with higher order cognitive processing, and understanding the expectations and regulations of university, potentially leading to anxiety and tension (Seary 2011). The learning mindset, or the way that students see their ability to learn a skill, can be influenced by previous educational experiences, leading to the feelings of inadequacy, and fear of humiliation, especially for mature age students if they have previously struggled with a task (Seary 2011). Due to the pressures put on mature age students, the learning environment can very easily become threatening and confronting (Seary 2011), requiring extra transitional support. Despite this, mature age students typically receive better marks and have more motivation to succeed than younger students (Kerri-Lee Krause, 2005).

It can be ascertained from existing practice and literature that some engineering students struggle with university. Transitional metrics can include difficulties academically (Entwistle 2009), socially (Rickinson and Rutherford 1995), their living situation impacting on their study (Yorke and Longden 2008) or their expectations (Holmegaard, Madsen et al. 2015). Different pathways and demographics can cause these metrics to have more chance of occurring (Attrition Working Party 1998), however all students will have different experiences and backgrounds, impacting on their university success. Despite these differences, there are commonalities that arise within transitional issues, such as awareness about available support services (Cuthbert and MacGillivray 2003). These commonalities can incorporate general transitional issues for all university students, as well as engineering specific transitional concerns. To better assist students throughout their undergraduate engineering university experience, this phenomenon must be further investigated to determine how best to help students, whilst meeting their individual needs.

Methodology

This study intends to determine transitional issues for students entering engineering courses at Swinburne University, to therefore identify key metrics which can suggest students are more likely to be at risk. To allow for a larger range of participants and the experience of support staff and academics, research will utilise semi structured interviews with relevant stakeholders to allow for a communicative dialog based on existing knowledge. Stakeholders were determined by the roles and responsibilities held by each individual. All participants provide different forms of support to engineering students throughout their transitional phase at Swinburne University, separated into the six categories shown below. The identified stakeholders were then emailed inviting them to participate in the research. The participants, who showed interest and were interviewed, were evenly distributed across the categories.

The participants were chosen from these six different support areas:

Student Advisors: responsible for centralised university based support services, such as accessability, LAS, student advancement

Directors of Academic Support Units: responsible for faculty based academic support services, such as MASH (maths help desk), programming help desk

Faculty Academics: responsible for overseeing faculty based academic support programs, such as study groups, progress review

Course Advisors: responsible for faculty course advice to engineering students

First Year Unit Lecturers: responsible for unit based support to students in respective subjects

Student Volunteers: responsible for student run support, such as the student union and rovers

From the determined stakeholder groups, 12 participants were interviewed about their experiences with students in their first year of engineering at Swinburne. All participants have been de-identified with pseudonyms used throughout this paper.
Interviews were carried out in a semi structured style, to allow for individual experiences to be explored, whilst ensuring all participants received the same interview structure and leads.

The data was then analysed thematically to find main themes. The analysis was completed in three parts. The first stage involved analysing five interviews chosen randomly, finding initial themes which the participants mention multiple times. The second part involved analysing the next five interviews, allowing for confirmation or contradiction of the themes, to check if the initial themes resonated in the second set of interview data, as well integrating individual themes that didn't initially fit with the model. Finally, the last two interviews were analysed to validate the model. From this analysis, saturation in the data should be reached, demonstrated by not finding any new themes in the last round of analysis.

Results

Thematic Analysis

The interview data has been analysed thematically as per the method stated in Educational Research (Creswell, 2008).

Ten themes were identified in the thematic analysis of the academic stakeholder interviews. As depicted in Figure 1. The themes have then been grouped into the three distinct ways that they impact upon students, with available support being linked to each section. The numbers represent the number of participants who spoke in depth about each theme; however, it is important to note that this does not reflect the importance level of individual themes. The themes from the thematic analysis are:

Student – Teacher Relationships

Student –teacher relationship is the understanding of the academic staff role and expectations from the student's perspective and the interaction that then follows. Jason states that students rely on teachers to be spoon-fed, and want to be provided all required information. Similarly, Nathan says learning is the responsibility of the student, and lecturer is not there to make them study, attend class, or do assignments. Luke finds that there seems to be something psychological about a door, which makes it less likely for students to visit a lecturer in their office. From the student perspective, Josh supports this, acknowledging that students don't know how to talk to or approach lecturers, and has on occasions had to walk students to staff offices because they were too scared and apprehensive. Student feedback that Josh has received, include that students feel that the lecturer or the tutor don't provide enough detail on how to do a project, supporting the spoon-fed notion that Jason experiences. Ryan finds that if you don't have an engaged teacher, the students will not be engaged. Josh points out that if a student has a good first year lecturer, the transition to university expectations and workloads become a lot easier.

External responsibilities

Commitments and responsibilities external to university can impact on a student's university success. Sandy, Ryan, Luke, Scott and Melissa all commented on the extra responsibilities that mature age students have outside university. Ryan mentioned financial implications of returning to study, and therefore the additional pressure on succeeding. Melissa stressed the difficulty of arranging a class timetable around work hours and other time commitments. Scott and Luke spoke about balance, with Luke emphasising effort versus mastery of a particular topic. Younger students often work 20 or more hours per week, to support themselves, family, or provide disposable income, which conflicts with study time or sleep.

Self-management

Self-management is the ability to manage time and workload independently without a provided structure. Brian wants students to take responsibility for their learning, Jason thinks students should be more independent about their learning and Josh thinks that students lack self-management.

Engagement with course

Engagement with a student's course, relies on students also being engaged with each unit. Nathan sees the importance of engagement for learning, however finds that most students do not meaningfully engage with tasks. Jack and Ryan mentioned that students can have the incorrect expectations of what the course will entail, resulting in disappointment and disengagement. Jack also spoke about external pressures forcing the student to study a specific course. Ryan often finds that students need to find a way to correlate the student's real interest to the course they are studying if they cannot withdraw.

Motivation

Motivation relates to the reason and drive that makes students learn. Ryan states that students must have autonomous motivation to succeed at university, because as classes increase in difficulty, motivation to please parents or family, or for the status and ego boost that the future career provides, is often not enough. Scott also mentions the importance of motivation in students, and having a direction to aim for. Scott believes that mature age students have more motivation for study, whilst high school students have the least motivation, due to a lack of purpose and reason for being in the course. However, IBL or placement changes maturity and motivation, and therefore improves academic marks in the students who transitioned straight from school.

Learning mindset

The learning mindset is how students perceive learning. Josh mentions that it is important for students to realise that making mistakes is part of the learning process. Ryan supports this by describing learning mindsets as either that mastery of a skill is a talent, or that mastery can be grown and developed. The latter mindset allows for mistakes. Scott, Josh and Jess find that students can easily be overwhelmed by the university system, with Josh and Luke finding that students fear making mistakes.

Student-student relationship

Student-student relationships relate to how students work together, and student involvement with university community. Jason believes that students should help each other more with class work and ask each other to help with problems or confusions that may arise. Scott also agrees about the advantages of studying in groups. Jack sees the benefit of study groups, not necessarily for studying, but as support groups, for students to have people to talk to, and improve motivation levels. Oliver found that unless international students make friends on campus, which is where he emphasised the importance of cultural clubs and SISA, they have trouble integrating to university life in Australia, which results in disengagement with their studies.

Academic skill set

There are necessary academic skills, such as maths, writing, comprehension and communication skills expected at the university level. Sandy speaks about how students both local and international struggle with writing to the extent that some are unemployable on graduation. Melissa often finds a language barrier when dealing with course enquiries, such as withdrawing from course versus subject, and being able to understand what they mean. Luke mentions that students can often perform the expected skills with CAS calculators but struggle when asked to do them by hand. Brian spoke about the naivety of trying to study engineering without any knowledge of physics.

Available support

The effectiveness of available support, relies upon student awareness of the support services available on campus. Brian and Jack agree that students are not aware of support services. Jack suggests that students do not pay attention when told because it doesn't apply to them, then when they need the information, they are not aware of it. Both Jack and Josh, find that students are often reluctant to follow up on something or seek help, despite claiming they want it. Jess mentions that students seem to find the Accessability service, but appreciate being told about other services.

Cultural Background

Cultural influences that impact the way students perceive learning and communication in academic environments. Josh points out that Asian students are typically less likely to ask questions, and need it to be teased out to find the problem. Jack also found that international students, especially Asian students were less likely to ask questions, due to their automatic respect given to academics, but found that Indian students, whilst still respecting, asked as many questions as local students. Luke however had a differing experience, whereupon international students with poor English tended to ask more questions to improve their understanding. Nathan and Sandy found international students were more likely to plagiarise.

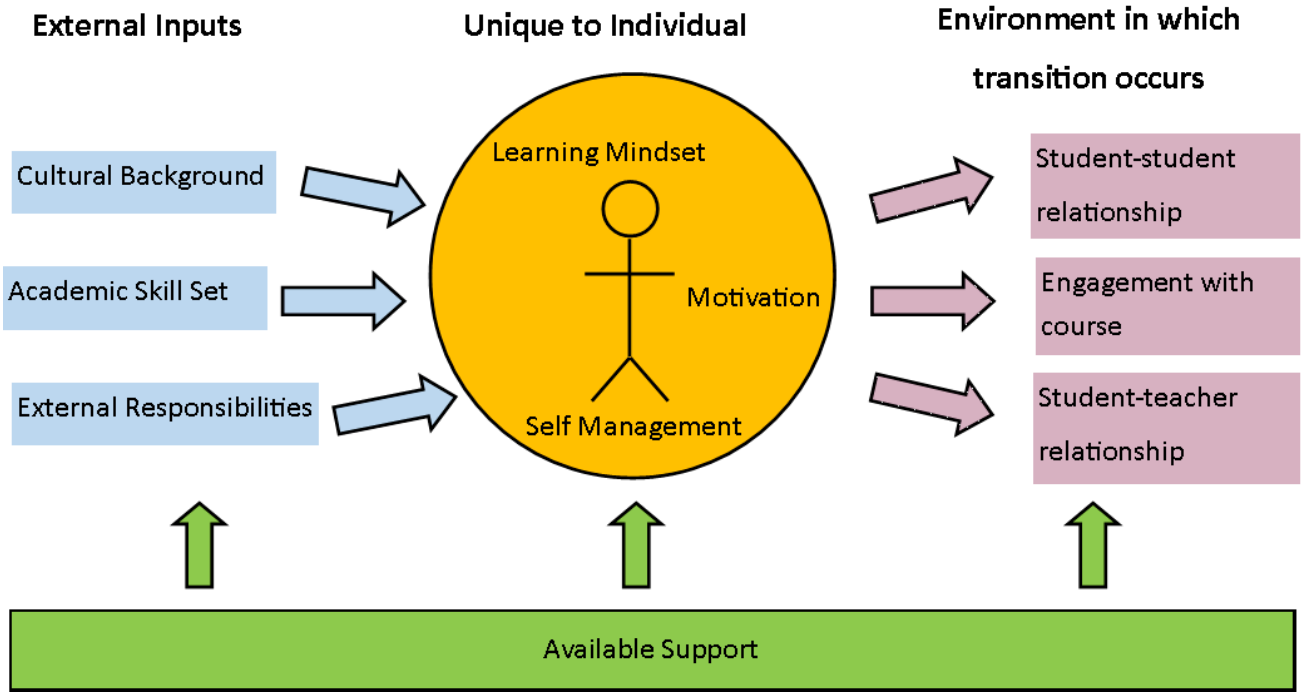

Figure 1. Thematic Analysis Diagram

Discussion

Each of these themes influences a student's successful transition to differing extents. As shown in the above diagram, the themes can be grouped into the three distinct ways that they impact upon students, with available support being linked to each section. The numbers represent the number of participants who spoke in depth about each theme; however, it is important to note that this does not reflect the importance level of particular themes.

External inputs

External inputs pressure the student, making transition difficult, by not being prepared for university, culturally or academically, or the impacts that external responsibilities can have on focus and time management for study.

External responsibilities like family and job commitments leverage the available energy left for study, resulting in the risk of not meeting the expectations and requirements that the lecturer sets, making self-management harder, especially for the workload, and it strains the potential student-student relationships and engagement on campus because of conflicting commitments. However, some participants noted that it can improve motivation and self-management skills because of the additional drive to succeed in all commitments (Scott, Luke, Ryan). This was found to be especially true in mature age students.

Cultural background can affect academic and social perceptions and expectations, what happens in Australia can be quite different to that of the culture they are used to. This can negatively impact the student-teacher relationship, through cultural misunderstandings (Brian), often resulting to partially self-chosen isolation with only people from their culture (Scott), leading to lack of engagement with the university culture and other students. This only becomes problematic, when the learning mindset and engagement of the chosen 'study friends' becomes compromised, and the students cannot motivate and help each other. The fear of being deported due to struggling academically increases the barrier that is put up, resulting in a lack of trust to seek help (Josh).

The academic skill set that students enter engineering degrees with, can positively or negatively influence their motivation based on their prior knowledge and understandings. This is greatly linked to a student's learning mindset. If students feel that they should already know the material, which they don't, and are unaware of any support to help them attain the prerequisite information, they often become disengaged with the unit, and then the course (Ryan). The student teacher relationship is crucial in this scenario, to ensure students do receive the required motivation and assistance to manage the unit. Furthermore, the awareness of available support by the student is also critical, to ensure that they receive the appropriate help. Whether that is for understanding Australian culture and university expectations, help with timetables, financial support or Accessability allowances around other commitments, or maths, English and other academic skills improvement.

Unique to individual

The second part of the diagram shows factors that are unique to the individual, motivation, learning mindset and self-management. Whilst most people have issues with these skills, the issues whilst similar in name, differ greatly in their manifestation and reason, therefore cannot be fixed with a one size all solution.

Self-management is central to university success. Without the ability to manage time, and workload independently, students will almost certainly fail. Collaboration with other students, and their lecturers will improve self-management skills, whilst increasing the motivation to try harder. External responsibilities will make time management more difficult, but as long as the student keeps a reasonable balance and focus, it should be doable. Support is available to students to learn how to manage workload, and time, as well as other skills to make study more efficient. However, students must be motivated and aware of the services to engage and utilise them (Jack, Josh).

Motivation is also important to the success of a student; it is the internal drive to do something. Unfortunately, many students rely on extrinsic motivation, or external pressure from family to study a particular course. It is imperative that students become autonomous and intrinsically motivated to get through the more challenging parts of their course (Ryan). As mentioned previously, student groups can motivate one another when they are disenfranchised with the unit, topic, or even the whole course. Likewise, a teacher can instil excitement about a topic, which will increase motivation.

However, motivation is linked to the learning mindset. If students feel that an ability can only be attained if they have the natural talent, then studying and practising, will not help, severely demotivating any individual. Conversely, if the student understands learning and attaining skills to be a growing process that requires work, failing or doing badly on an assessment is only a marker that more works to be done, instead of labelling the student unable (Ryan).

Environment in which transition occurs

The third section is the environment in which transition occurs: engagement with the course, student-student relationships and student-teacher relationships. Engagement and motivation are quite similar, however were spoken about independently of each other by the participants. Engagement is therefore the external manifestation of a student's internal motivation. Engagement with the unit, and therefore the course, is pivotal to the student's self-management, their relationship with their lecturer and tutor, and their other students, depending on the level of disengagement.

The relationship with other students can enhance or decrease the level of engagement with university and the course, but can provide a sense of belonging and identity, encouraging further engagement with the student's studies. Seeing other students struggle and manage course material can improve a student's learning mindset, and develop the understanding that making mistakes is ok. Likewise, the communal experience of being overwhelmed by workload or difficulty of a task, builds a sense of belonging.

The student-teacher relationship whilst seen as the main contact with the university tends to only impact on the success of the particular unit at a worst case scenario. A lecturer or tutor who the student dislikes, or does not get along with, is often brushed off as bad luck, and a greater relationship with their peers is formed to succeed in the unit. Conversely, a good lecturer will set their students up with helpful self-management strategies and a healthy learning mindset (Josh). Therefore, suggesting that whilst the student-teacher relationship is not necessarily detrimental when negative, the positive alternative greatly enhances a student's independence, engagement, and university skill set for the future.

Other factors

Interestingly, whilst demographics were discussed, they were not seen as a factor for student's transition. This is because of the differing nature of circumstances, and the uniqueness of each student. A few participants mentioned that it was a fifty-fifty chance as to whether pathway students would succeed in an engineering degree, and there was nothing that suggested the future success or failure, that had been recognised by university metrics. Similarly, examples were given of students with many hindrances and difficulties challenging their ability to study, but they succeeded anyway, whilst students, who appeared to be able to succeed, based on their demographics, did not. Additionally, students who had failed and were completely disengaged have been turned around and are now prevailing in their studies. Demographics do not define a student or what they are capable of. If it is assumed that every student who gained entry to the course is capable, then it is reliant on provided support to help each and every student triumph.

Conclusions

From this model, three stages are clearly shown, of where university and support intervention is needed to help students with each deterrent to success. Cultural differences, external responsibilities and academic skill sets, need to be dealt with before or at the beginning of a student's transition and involvement with the university. Factors internal and unique to the individual require self-managing strategies, which can be encouraged and supported by the university to allow for every individual to grow and thrive. Finally, the environment, in which transition occurs, needs to be ready for every student. The student awareness of available support services at every step is crucial, to ensure every student receives the help and assistance that they need, to help them achieve. Further research needs to be conducted to understand how to best provide these supports to students.

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