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Student Engagement Amongst Regional Australian Undergraduate Students

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Abstract: Students' level of engagement and approach to learning can significantly impact their overall success in a course. This study used the student course engagement questionnaire (SCEQ) to assess the engagement levels of first-year undergraduate students studying three different introductory units (chemistry, biology and nursing) at a regional Australian university. No significant differences in engagement were found between genders, or for students studying different units. One of the most notable factors influencing engagement was student age, with students under 20 years of age scoring significantly less than mature age students across nearly all measures of engagement. Tertiary educators could use several complementary approaches to improve engagement in younger students, including the use of interactive multimedia and social media to connect with students, making the unit content relatable and relevant to students' lives, providing authentic and engaging assessment items, and pursuing interactive approaches to lectures and tutorials. Given that many university students take an introductory science course during their first year, these results are likely to be relevant across a range of disciplines.

Keywords: biology education; chemistry education; first-year undergraduates; nursing education; Student Course Engagement Questionnaire (SCEQ).

Introduction

It is widely accepted that there is no single optimum approach toward learning, but that it may depend upon other variables including the study topic, delivery mode, required learning outcomes and the preferred learning style(s) of the individual student (Coertjens et al., 2016; Heoncheol et al., 2020). Nevertheless, successful learning styles are characterised by several common features, such as a high level of student engagement with the topic content, strategies for memorising required information (e.g., mnemonics, acronyms, connecting terms with visual concepts or emotional experiences, mind maps) and connecting newfound information to previously learnt principles or concepts. For example, a strategic approach aiming for a deeper understanding of the topic is generally more productive than taking a "surface" learning approach (i.e. studying only to pass the final exam) (Diseth, 2013; Dolmans et al., 2016; Everaert et al., 2017; McDonald et al., 2017; Richardson et al., 2012). In order to avoid being overwhelmed by the quantity of learning material comprising most university units, the student must determine and utilise the most effective method in which they learn. With a defined understanding of their 'best approach' toward learning, students can seek out experiences that draw on the strength of their approach, while still making a conscious effort to develop their skills in other learning approaches to help them cope in different situations, and also to understand the learning approaches of others. For most students, this requires quite a different approach toward learning compared to what they may have experienced in secondary

school or in the workplace. However, from the perspective of a tertiary educator, student engagement with the learning topic(s) may be easier to influence than their method of learning. Increasing engagement in the first year at university may promote the successful transition to higher education and this is particularly relevant to students traditionally under-represented in higher education, and students who have ill-formed expectations of what to expect as they transition into higher education. Also, increased engagement generally benefits all students, although the effects are even greater for lower ability students (Kuh, 2003). This compensatory effect of engagement can raise the academic achievement of students entering undergraduate study with sub-optimal prior educational experiences. Also, increasing engagement in the first year at university is a mechanism to promote the successful transition to higher education Consequently, this study aims to investigate the engagement levels among science/health undergraduate students and determine the impact of age, gender and area-of-study on student engagement.

Literature review

In order to learn effectively and succeed in tertiary studies, students must develop the analytical thinking skills required to investigate topics in depth and to develop a critical perspective on them, rather than merely memorising information and trying to reproduce it in an assessment or exam (Dolmans et al., 2016; Everaert et al., 2017). As mentioned, the most suitable learning approach in this environment would be a deep learning approach, which focuses on obtaining a thorough understanding of the topic and connecting it to previously learnt information, rather than a surface learning approach which prioritises the short-term memorisation of all information presented (Brown et al., 2014). Nevertheless, it is important to note that there is a fine balance between different learning strategies (Dinsmore and Alexander, 2012) and that learning approaches by a given student may change over time (McDonald et al., 2017). Additionally, in time-limited situations, a deep learning approach may be unfeasible due to the significant investment of time required to use this approach. Hence in such situations, students may successfully use a strategic learning approach, which emphasises attention toward the structure of the presented material, lecture styles and expected exam format, allowing the material to be learnt within a scaffolded framework (Brown et al., 2014). This strategic approach toward learning can be very effective; however, if students solely focus on performing well in assessments and learning the material within a rigid framework, they risk missing out on the excitement of intellectual discovery, the generation of unexpected ideas and insights, and may fail to develop their own approach toward the subject. In turn, these latter activities may be important for achieving good grades rather than solely spending time studying the material (Everaert et al., 2017).

With increasing numbers of mature-age or "non-traditional" students entering into the tertiary education sector (Heagney and Benson, 2017), it is also important to consider the specific learning approaches and needs of this group of students in addition to the "traditional" school-leaving student cohort. On the one hand, mature-age students can suffer from the lack of recent involvement in formal learning (Mallman and Lee, 2016) and typically have more responsibilities outside of their study commitments (Baglow and Gair, 2019; O'Donnell and Tobbell, 2007; Stone and O'Shea, 2013). These students may require increased institutional support and guidance, such as greater facilitation of practical learning and peer-to-peer interactions, improved access to university services and information, more frequent and personalised feedback, and increased flexibility in admissions, study load and assessments (Benson et al., 2013; Heagney and Benson, 2017). However, research has suggested that mature-age students are generally highly motivated (Heagney and Benson, 2017), have better time-management skills (Trueman and Hartley, 1996), and tend to use a

deep learning approach (Howard and Davies, 2013). Consequently, they are often more engaged with their studies (Rabourn et al., 2018; Timms et al., 2018), and as a result, may have a better academic performance than school-leaving students (McKenzie and Gow, 2004).

In recent years, the concept of student engagement has steadily become more prominent in the Australian higher education sector (Kahu and Nelson, 2018; Matthews, 2016; Naiker et al., 2020; Rizvi, 2017). Reduced student engagement has been linked to student attrition, with significant implications for the Australian higher education context now that student attrition numbers form a key component of performance-based government funding for tertiary institutions (Bell et al., 2018; QILT, 2020). In the higher education sector, student engagement is often referred to as the level of participation in various aspects of the learning process, which extends to students' level of motivation to learn the subject material and progress in their studies. Student engagement is increasingly being positioned as a defining characteristic of high-quality teaching in higher education because as a concept, it can comfortably serve the purposes of various stakeholders across learning and teaching environments, institutional management, and in the context of national policy (Ashwin and McVitty, 2015).

In the context of the scholarship of learning and teaching, student engagement is considered to be a route to success for the student (Hourigan, 2013) and equally an outcome of excellent teaching practice for the lecturer. One systematic literature review of 38 studies highlighted the close relation between social interaction in courses and achievement, with the latter strongly associated with the stimulation of meaningful learning by presenting information in a clear way, relating it to the students, and using conceptually demanding learning tasks (Schneider and Preckel, 2017). Another recent meta-analysis demonstrated a "moderately strong and positive correlation" between the overall level of student engagement and their academic achievement (Lei et al., 2018). Other studies have found that student engagement improves academic aspects of the student learning process, such as improved retention of the subject material (Khademi Ashkzari et al., 2018), enhancing student perseverance (Khademi Ashkzari et al., 2018), encouraging a transformative learning approach (Kahu, 2013), and increasing the perceived relevance of the curriculum (Trowler, 2010). In turn, this helps students develop a mindset of lifelong learning (Artess et al., 2017) and increases their readiness for the workplace (Krause and Coates, 2008). Student engagement also brings a host of more subjective, non-academic benefits for the student, including improved wellbeing (Field, 2009) resulting from increased personal and social development (Zwart, 2009) and a greater sense of belonging (Wentzel, 2012). As a consequence, this can enhance institutional patriotism and reputation (Kuh et al., 2006) and increase desirable citizenship behaviours (Zepke et al., 2014).

It can be argued that while students are responsible for constructing their own knowledge, the learning process is also dependent upon institutions and staff generating learning environments that stimulate student involvement in their learning (Czerkawski and Lyman, 2016; Rienties et al., 2018). This shared responsibility for engagement is supported by Bryson (2014) in his distinction between engaging students (what staff and institutions do to engage students) and students engaging (what students do). However, the amount of time invested into studying is less important than having an effective approach toward learning (Everaert et al., 2017). Particularly in their initial years of tertiary studies, many students do not have a good understanding of which learning approaches work best for them, with this knowledge evolving throughout their studies. Supporting this observation, McDonald et al. (2017) found that students tended toward a surface learning approach during their first year of study but had shifted to deeper learning approaches by their third year. Given the importance of this observation, future longitudinal investigations are recommended to further validate this point.

Whilst it is clear that student engagement remains a positive component of learning, creating the conditions that foster student engagement, success and retention remains a perennial issue within the higher education sector (de Silva et al., 2018). Traditionally, student satisfaction has been prioritised by education providers attempting to quantify student success; however, there have been calls for a more detailed perspective of the student experience that considers who and what students are becoming (Bowden et al., 2019). Hence while many universities have attempted to improve student engagement by implementing policies aimed at the teaching staff, the degree to which this has been effective in improving student engagement on the ground should be quantified through methods such as student evaluation and feedback surveys (Kandiko Howson and Buckley, 2020; Mandal, 2018). In this way, educators also have an opportunity to respond with their experiences. This continuous process of improving the scholarship of learning and teaching will better inform all stakeholders in view of improving the learning environment in future offerings.

With this in mind, the present study aims to quantify the level of engagement in a cohort of first-year undergraduate students at a regional Australian university, and to highlight any demographic features that may influence student engagement, such as student gender, age and their area of study.

Methods

Our study population was first-year undergraduate students at Federation University Australia (FedUni) who were enrolled in an introductory chemistry, biology, or nursing unit. FedUni is a regionally focussed, dual-sector education provider in the state of Victoria, Australia. Notably, there are typically high numbers of mature age (>21 years) students enrolled at FedUni. In the Bachelor of Science, an estimated 40% of students fall into the >21 year age bracket (Naiker and Wakeling, 2015). In the Bachelor of Nursing this number is much higher, with approximately 70% of students being over 21 years of age.

Students enrolled in the introductory chemistry and biology units included in this study were pursuing a Bachelor program in a science-related field, as these units form a core (compulsory) part of the first-year program structure. Similarly, all students enrolled in the introductory nursing unit were pursuing a Bachelor of Nursing qualification.

This study utilised the student course engagement questionnaire (SCEQ) instrument, which has previously been used for assessing student engagement in undergraduate classes (Brown et al., 2017b). This instrument was first proposed by Handelsman et al. (2005), and has been used by numerous researchers since its inception (Brown et al., 2017a; Brown et al., 2017b; Miller et al., 2011; Nasir et al., 2020; Taylor et al., 2011). The SCEQ comprises of 23 statements (items), such as "raising my hand in class", "participating actively in small group discussions" and "being organized" (Table 1). The only change made from the original SCEQ instrument (Handelsman et al., 2005) was question 6, where "*Going to the professor's office hours to review assignments or tests or to ask questions*" was changed to "*Asking the teacher to review assignments or tests*" in order to make the terminology more familiar to Australian students. For each item, students are asked to provide a response on a scale of 1-5, ranging from "not at all characteristic of me" (1) to "very characteristic of me" (5). In addition, demographic information on the gender, age bracket and study program of the student were collected. The chosen age brackets (i.e. <20, 20-25, 26-35, >35 yrs) were arbitrary, although they were selected to approximately correspond to school-leavers, "recent" school leavers, "younger" mature age students, and "older" mature age students, as we hypothesised that there may be a difference in engagement between these age groups (Rabourn et al., 2018). The size of each age bracket (i.e. number of years encompassed) was based on preliminary observations on the number

of students of each age, to ensure that a sufficient number of students were included in each bracket to allow for robust statistical analysis. All survey responses were collected anonymously.

All first-year students enrolled in an introductory chemistry unit (Chemistry I), introductory biology unit (Biology I) or a Bachelor of Nursing at Federation University in Semester 1, 2015, were invited to take part in this research project. The students studying the introductory biology or introductory chemistry unit were predominantly from Biomedical Sciences or a Bachelor of Science, with other commonly encountered Bachelor programs including Veterinary and Wildlife Science and Food Science. Data were collected from students across two campuses (Gippsland and Mt Helen). Informed consent was obtained from all participants prior to the collection of their responses. Ethical approval to conduct this study was obtained from Federation University's Human Research Ethics Committee (approval no. B15-055).

Table 1. The items of the student course engagement questionnaire (SCEQ) instrument, sorted by subscale.

Item	Description	Original subscale (Handelsman et al., 2005)	Subscale assigned by Brown et al. (2017a)
Q20	Making sure to study on a regular basis	Skills	Skills
Q13	Putting forth effort	Skills	Skills
Q4	Doing all the homework problems	Skills	Skills
Q17	Staying up on the readings	Skills	Skills
Q10	Looking over class notes between classes to make sure I understand the material	Skills	Skills
Q14	Being organized	Skills	Skills
Q9	Taking good notes in class	Skills	Skills
Q23	Listening carefully in class	Skills	Skills
Q5	Coming to class every day	Skills	Skills
Q21	Finding ways to make the course material relevant to my life	Emotional	Emotional
Q22	Applying course material to my life	Emotional	Emotional
Q8	Finding ways to make the course interesting to me	Emotional	Emotional
Q7	Thinking about the course between class meetings	Emotional	Emotional
Q11	Really desiring to learn the material	Emotional	Emotional
Q1	Raising my hand in class	Participation/interaction	Participation
Q3	Asking questions when I don't understand the instructor	Participation/interaction	Participation
Q18	Having fun in class	Participation/interaction	Emotional
Q2	Participating actively in small group discussions	Participation/interaction	Participation
Q6	Asking the teacher to review assignments or tests	Participation/interaction	Participation
Q19	Helping fellow students	Participation/interaction	Participation
Q15	Getting a good grade	Performance	Performance
Q16	Doing well on the tests	Performance	Performance

Q12	Being confident that I can learn and do well in the class	Performance	Performance

Survey responses were received from a total of 318 students. These were predominantly from the Bachelor of Nursing program (125 students), with 106 students from Chemistry I and 87 students from Biology I units (see Table 3). The majority of respondents (70%) were female (Table 3), predominantly due to the high number of females enrolling in the Bachelor of Nursing program (98% of respondents in the introductory nursing unit were female; a little higher than the typical proportion of 90% female students in this program (Terry and Peck, 2020). In the introductory biology unit, approximately 55% of respondents were female, while numbers from each gender were approximately equal in the introductory chemistry unit. Missing or invalid responses on the SCEQ instrument were scored as a 3. Where demographic data was missing, the respondent in question was excluded from analyses pertaining to that demographic parameter only.

For each student, the mean score was calculated for each subscale, according to the structure proposed by Handelsman et al. (2005) and confirmed by exploratory factor analysis performed on the results from this study: "skills" (n=9 items), "emotional" (n=5 items), "participation/interaction" (n=6 items) and "performance" (n=3 items). Statistical analyses were performed in R Studio, running R 4.0.2 (R Core Team, 2020). As the data were approximately normally distributed, one-way ANOVA followed by *post hoc* Tukey testing was used to assess statistical differences between different units, programs and age groups. Independent sample *t* tests were used to assess gender-based differences. Principal component analysis was performed in the Unscrambler X, while factor analysis was performed in IBM SPSS (v25).

Results

Initially, exploratory factor analysis was performed on the dataset (comprising 318 completed questionnaires) to confirm the validity of the survey instrument in the regional Australian undergraduate student population. The results suggested a solution with 5 factors (i.e. factors where the eigenvalue was greater than 1), with a Kaiser-Meyer-Olkin measure of sampling adequacy of 0.898 and significant results ($P<0.001$) for Bartlett's Test of Sphericity. As the fifth factor contributed little to the model (explaining only 4.6% of the total variability), only the first four factors were used in subsequent analyses. Further exploratory factor analysis (principal component analysis method with varimax rotation and 4 factors) using just these factors revealed the factor loadings associated with each question shown in Table 2. Furthermore, this agreed with the broad groupings of simple principal component analysis (PCA) performed on the data (Figure 1). The assigned subscales largely concurred with those found by Handelsman et al. (2005), confirming the validity of the SCEQ instrument in the student population in this study.

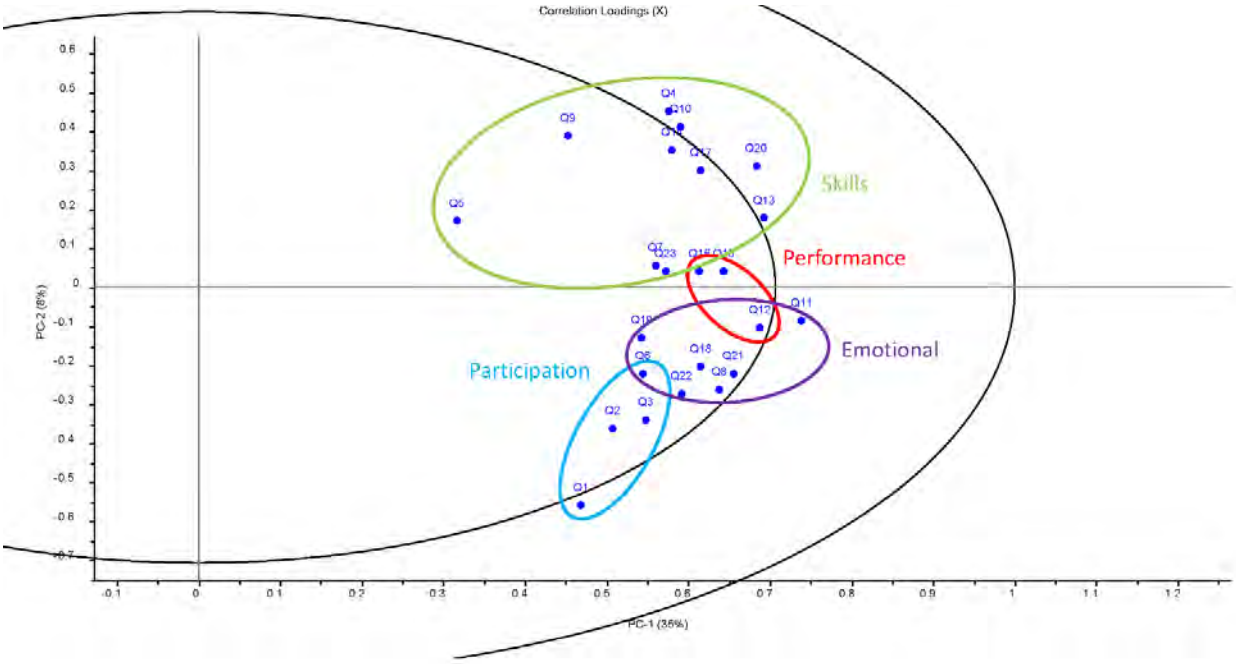

Figure 1. Factor loadings for the PCA performed on the engagement data.

Table 3. Loading correlations found through exploratory factor analysis (principal component analysis with varimax rotation).

Item	Description	Factor 1 "Skills"	Factor 2 "Emotional"	Factor 3 "Performance"	Factor 4 "Participation"	Original subscale (Handelsman et al., 2005)
Q10	Looking over class notes between classes to make sure I understand the material	0.736				Skills
Q9	Taking good notes in class	0.696				Skills
Q20	Making sure to study on a regular basis	0.675				Skills
Q4	Doing all the homework problems	0.661				Skills
Q14	Being organized	0.648				Skills
Q17	Staying up on the readings	0.586				Skills
Q13	Putting forth effort	0.482		0.485		Skills
Q7	Thinking about the course between class meetings	0.409	0.308			Emotional
Q23	Listening carefully in class	0.364				Skills
Q5	Coming to class every day	0.310				Skills
Q21	Finding ways to make the course material relevant to my life		0.834			Emotional
Q22	Applying course material to my life		0.823			Emotional
Q8	Finding ways to make the course interesting to me		0.660			Emotional
Q18	Having fun in class		0.568			Participation
Q11	Really desiring to learn the material		0.523		0.393	Emotional
Q19	Helping fellow students		0.461		0.355	Participation
Q16	Doing well on the tests			0.850		Performance
Q15	Getting a good grade			0.833		Performance
Q12	Being confident that I can learn and do well in the class			0.645		Performance
Q1	Raising my hand in class				0.838	Participation
Q3	Asking questions when I don't understand the instructor				0.763	Participation
Q2	Participating actively in small group discussions				0.642	Participation
Q6	Asking the teacher to review assignments or tests				0.518	Participation

Subsequently, the responses to each question from all participants (318 responses) were pooled to analyse for the effects of gender, age and other demographic data on student engagement. The mean engagement score across all students surveyed was 3.53 ± 0.58 (n=318), indicating an average level of engagement observed somewhere between "moderately characteristic of me" (equivalent to a score of 3) and "characteristic of me" (equivalent to a score of 4) across all items. No significant differences were found for any subscale when the data were analysed by unit (Chemistry I, Biology I or Nursing), as shown in Table 3. In addition, the only significant difference by gender was observed for the Skills subscale, where males reported their Skills engagement to be lower than females, on average (independent samples t-test with Welch's approximation; $P<0.05$). However, their scores on all other engagement subscales (Emotional, Participation and Performance) were not significantly different.

A one-way ANOVA revealed significant differences in the engagement of students in the different age brackets (Table 3). For the average engagement and almost all subscales, the reported level of engagement showed a general increase with age (Figure 2), with students who were less than 20 years old showing the lowest scores. This difference was most significant for the Emotional and Participation engagement subscales ($P<0.001$ for both). There was a large number of mature age students among this student cohort (Table 3), as previously reported for this university (Naiker and Wakeling, 2015). The majority of mature age students (>25 years old) were enrolled in the Bachelor of Nursing program, with significantly higher numbers than expected by chance (Chi-square test; $P<0.05$).

Table 3. Mean scores for different groups of students across each of the four SCEQ subscales.

Category		Skills	Emotional	Participation	Performance	Average
Gender	Female (n=215)	3.78 ± 0.60	3.49 ± 0.68	3.26 ± 0.66	3.67 ± 0.79	3.55 ± 0.55
	Male (n=91)	3.59 ± 0.65	3.41 ± 0.78	3.28 ± 0.76	3.82 ± 0.76	3.49 ± 0.60
	Significance	*	*NS*	*NS*	*NS*	*NS*
Unit	Biology (n=87)	3.76 ± 0.63	3.49 ± 0.78	3.25 ± 0.70	3.70 ± 0.80	3.55 ± 0.60
	Chemistry (n=106)	3.63 ± 0.66	3.43 ± 0.76	3.22 ± 0.75	3.58 ± 0.86	3.46 ± 0.60
	Nursing (n=125)	3.78 ± 0.61	3.48 ± 0.65	3.31 ± 0.66	3.81 ± 0.69	3.58 ± 0.54
	Significance	*NS*	*NS*	*NS*	*NS*	*NS*
Age	<20 yrs (n=166)	$3.61 \pm 0.60^{a,b}$	3.28 ± 0.68^{a}	3.00 ± 0.60^{a}	3.60 ± 0.80^{a}	3.36 ± 0.50^{a}
	20-25 (n=70)	3.87 ± 0.54^{a}	3.62 ± 0.63^{b}	3.50 ± 0.63^{b}	$3.76 \pm 0.71^{a,b}$	3.69 ± 0.51^{b}
	26-35 (n=42)	$3.85 \pm 0.67^{a,b}$	3.72 ± 0.70^{b}	3.73 ± 0.55^{b}	4.02 ± 0.67^{b}	3.80 ± 0.56^{b}
	>35 (n=18)	3.98 ± 0.70^{a}	3.94 ± 0.61^{b}	3.77 ± 0.70^{b}	$3.89 \pm 0.86^{a,b}$	3.90 ± 0.59^{b}
	Significance	**	***	***	*	***
Program	Biomed Sci (n=53)	$3.73 \pm 0.67^{a,b}$	$3.47 \pm 0.79^{a,b}$	3.22 ± 0.75	4.04 ± 0.63^{a}	3.57 ± 0.61^{a}
	BNurs (n=125)	3.78 ± 0.61^{a}	3.48 ± 0.65^{a}	3.31 ± 0.66	$3.81 \pm 0.69^{a,b}$	3.58 ± 0.54^{a}
	BSci (n=53)	$3.69 \pm 0.62^{a,b}$	3.57 ± 0.63^{a}	3.30 ± 0.73	3.67 ± 0.75^{b}	3.55 ± 0.54^{a}
	VetSci (n=24)	3.36 ± 0.60^{b}	3.08 ± 0.73^{b}	2.97 ± 0.65	2.83 ± 0.93^{c}	3.11 ± 0.62^{b}
	Significance	*	*	*NS*	***	**

NS – not significant ($P>0.05$), * $P<0.05$, ** $P<0.01$, *** $P<0.001$

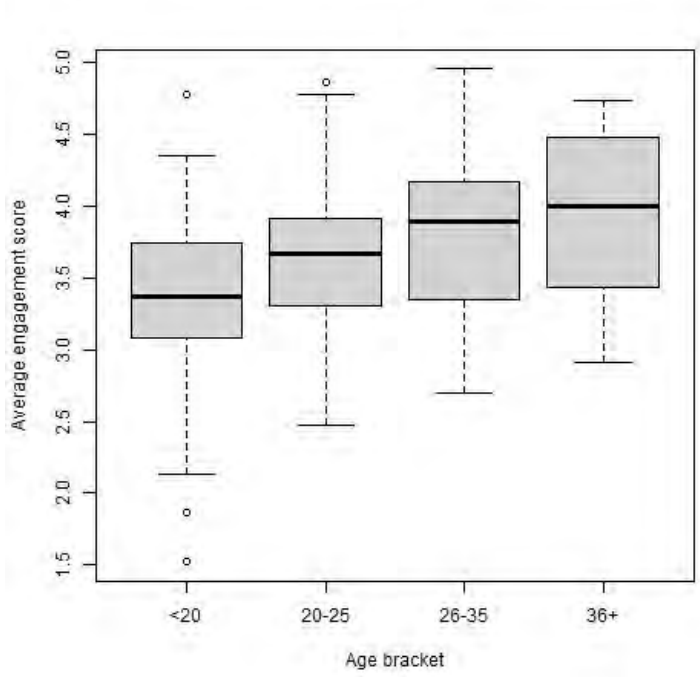

Figure 2. The relationship between the average engagement of students and their age bracket.

In addition, one-way ANOVA analyses were conducted to assess differences in engagement from students of different programs (degrees). In order to avoid skewing the statistics due to the small number of students in some programs, only the four largest programs (each comprising >20 students) were used in this analysis. In general, students from the Veterinary and Wildlife Science program showed much lower engagement with the course material across all scales, except for the Participation subscale (Table 3). The most significant differences by program were observed for the Performance subscale, where Biomedical Science and Nursing students scored the highest. There was a significant difference in this subscale between Biomedical Science and other science students, with Veterinary and Wildlife Science students scoring over one full unit lower (on a four-unit scale) compared to the Biomedical Science students (Figure 3).

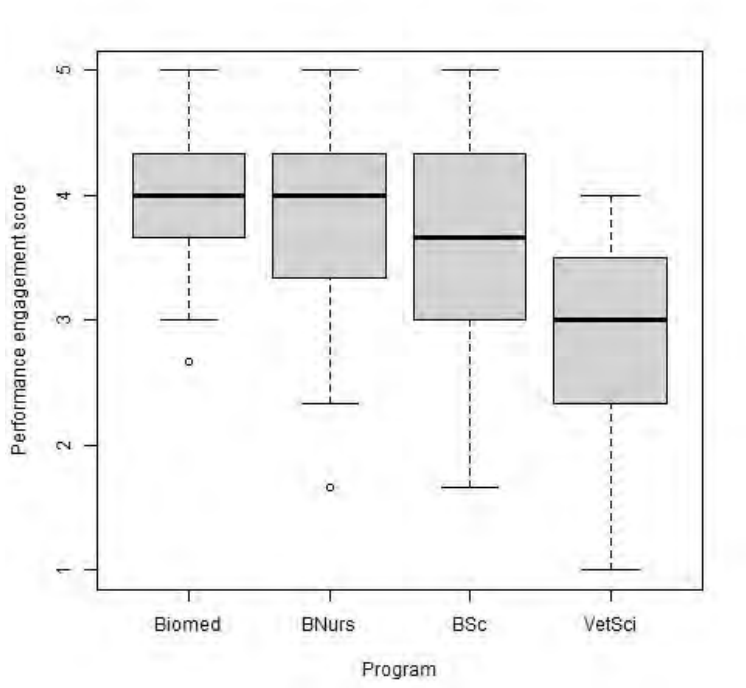

Figure 3. Performance engagement scores for students from each of the four major programs.

Discussion

As no significant difference in observed engagement was found based on the unit that a student was studying (introductory biology, chemistry or nursing), this indicates that student engagement did not show any clear trends/correlations with the unit material being taught. In other words, students studying chemistry were as engaged with the material as those studying biology or nursing. Similarly, the only significant difference by gender was for the skills subscale, where females reported slightly higher levels of their skills engagement with the subject material (Table 3). However, the broad lack of gender differences across most engagement subscales contrasted with Kuh (2003) and Byrnes (2011), who reported that females were on average more engaged with their studies compared to males. This reduced gender gap may be due to the regional student population examined in this study, in contrast to most previous studies which have focused on students from urban regions – primarily in the United States.

Significant differences were found across all engagement subscales except "participation" based on the Bachelor program that the students were studying in their first year at university. Whilst no significant differences in engagement were observed between the Biomedical Science and Bachelor of Nursing students, the Bachelor of Science students reported significantly lower scores on the "performance" subscale only. The Veterinary and Wildlife Science students had lower scores for engagement across three subscales ("skills", "emotional" and "performance") but not for the "participation" subscale. The findings presented here suggest that Veterinary and Wildlife Science students, while reporting the same level of participation with the subject material as students from other Bachelor programs, found it more difficult to emotionally connect with the subject material and displayed poorer study and revision skills. In turn, this negatively impacted on their anticipated level of performance in the unit of study (Figure 3), which was significantly lower than that found for students from any other program. The emotional disconnect could stem from the fact that biology and chemistry are core foundational units, covering foundational material required later in the different Bachelor programs. The primary interest for Veterinary and Wildlife Science students would be to learn about animals; hence they may question the relevance of introductory subjects such as chemistry. Conversely, students undertaking a Bachelor of Science majoring in chemistry would be more likely to find these core introductory subjects more relevant and thus more engaging.

On a scale of 1-5, the mean anticipated performance score of Veterinary and Wildlife Science students for the subscale performance was just 2.83, compared to an average of 4.04 for Biomedical Science students. Students from both programs were enrolled in the introductory chemistry and biology units; hence the differences in student engagement between programs was not due to the content material – which was the same for all cohorts – but rather due to intrinsic differences in the student cohorts from different programs. Within the scope of the present study, we were unable to investigate whether these differences are due to the demographics of students who chose to study in a specific program, or whether they were due to differences in the content and delivery of material in other first-year units besides those being studied here (i.e. introductory biology and chemistry). Both bachelor programs require completion of mathematics and at least one science subject at a Year 12 level (final year of high school). It is worth noting that the relationship between engagement, choice of study program and academic performance presents a "chicken and egg" style situation. Some fields of study may require specific types of engagement for students to perform well academically. However, students' intrinsic level of engagement with their studies may influence their choice of program. For example, students with lower levels of engagement may choose academically "easier" areas of study and have different career goals. For example, most Veterinary and Wildlife Science students are likely to have a premediated expectation to be working with animals (which does not occur during their first semester of study). On the other hand, many Biomedical Science students may be aspiring to use this program to enter a Doctor of Medicine or other postgraduate programs, and hence may have a greater motivation to perform well in their studies. Studies clarifying the relationship between intrinsic student engagement and their choice of study program would be of great benefit.

Due to the notable variation in engagement levels found in the Veterinary and Wildlife Science student cohort, further investigative data analysis was performed for this program alone. The majority of students (86%) were female, with 71% being under 20 years of age, and the remaining 29% between 20-25 years old. The young age demographic in this group is likely to have negatively impacted on their average engagement scores, given the positive correlation between age and engagement (Figure 2), rather than being wholly due to the program content. Indeed, when the <20 years age group was compared between the four major programs, a significant difference was only found for the Performance subscale (one-way ANOVA; $P<0.001$), where Veterinary and Wildlife Science students scored an average of 2.8 out of 5, compared to 3.5-4 out of 5 for the remaining three programs. In terms of their skills engagement, students from the Veterinary and Wildlife Science program reported positive scores for "coming to class every day" (mean score of 3.96 out of 5), "taking good notes in class" (3.96/5) and "listening carefully in class" (3.63/5) but tended to fall short in areas such as "doing all the homework problems" (2.83/5) and "staying up on the readings" (2.92/5). Students were also less likely to report "having fun in class" (2.83/5) and were not confident that they "could learn and do well in the class" (2.58/5), hence they were much less likely compared to students from other programs to see themselves "getting a good grade" for the unit (mean score of 2.88/5; $P<0.001$; independent samples *t*-test).

Another notable finding of this study was the difference in engagement between different age groups. A one-way ANOVA showed statistically significant differences between age groups for all engagement subscales ($P<0.05$ for all), although post-hoc Tukey testing was unable to isolate which age groups were statistically different for one of the subscales (skills). For both the emotional and participation subscales, the mean level of engagement increased with increasing age of the students (Figure 2), with students under 20 years of age showing significantly lower results than students from all other age groups. Students from this age group are likely to be recent secondary school leavers and consequently may not be used to the more flexible, self-driven independent style of learning associated with university studies. Compounding this, most students would be living away from home for the first time, as well as trying to support themselves through some form of part-time employment, which could negatively affect their study-work-life balance. Another often-overlooked factor is that regional universities such as FedUni attract a high proportion of 'first in family' students, who may be less prepared for higher education studies. For example, Terry and Peck (2020) reported that 52% of students from the Bachelor of Nursing program at FedUni were the first from their family to attend

university. These students would benefit from increased support from their institution and lecturers (Groves and O'Shea, 2019).

A similar trend of increasing engagement with age was observed for the performance engagement, although the 26-35-year category showed the highest engagement scores for this subscale. Nevertheless, it was evident that overall student engagement increased significantly between students who were less than 20 years of age and those who were over 20 years of age. It can be postulated that this lack of engagement may play an important role in the attrition rates of younger students; hence intervention programs aiming to improve engagement (through methods such as peer mentoring) may help in reducing attrition rates. Longitudinal studies establishing the relationship between engagement and student age or experience would also be greatly beneficial in this respect.

The increase in engagement with age, as observed in this work, concurs with previous research on first-year university students from Texas, which found that non-traditional-age students (those 24 years of age and older) showed greater engagement with topic material compared to traditional-age students (<24 years of age) and were more likely to engage in educationally purposeful activities (Gibson and Slate, 2010). Other studies have found that non-traditional-age students are generally more prepared, complete more drafts of assignments and ask questions in class (Wyatt, 2011), leading to increased overall engagement with their study (Rabourn et al., 2018). It is highly likely that these students are better prepared for university study by their life experiences gained through work and/or volunteer activities which they are able to apply to their educational experiences (Kahu et al., 2013). Such mature age students will have acquired life skills through their general interactions in varying facets of life and furthermore have a more holistic view of university as an opportunity to upgrade their skills and job prospects via gaining a formal qualification. This desire to succeed – whether it is driven by a desire to change careers or move to a more senior position – may provide mature age students with a greater tendency to take ownership of their study and complete the required tasks with confidence. Furthermore, mature age students are more likely to wait to get into the course which they want to study, further increasing their motivation and engagement with the course.

Another factor to consider is the increased risk that mature age students must accept when undertaking further education. They often have numerous other commitments which they must either juggle or sacrifice throughout the duration of their degree; which may lead to a mindset that they must successfully complete their studies. For this reason, Compton et al. (2006) described adult learners as having focused educational goals, with an intrinsic (internal) motivation to learn. However, these extra-curricular commitments can also increase attrition risk (Gibson and Slate, 2010); thus increased flexibility from educational providers may be required (Kahu et al., 2013). In contrast, younger students are often less committed to their studies, with a perception that they can always "get a job" if tertiary study does not work out for them. Such students – typically coming directly from a school setting – may have more difficulty with skills required in tertiary education, such as time management and undertaking independent, self-directed learning (Beaumont et al., 2016; Christie et al., 2013).

The major findings of this study and recommendations for policy makers and educators are summarised in the following points:

- The validity of the SCEQ instrument was confirmed in the study population, supporting the future use of the instrument for monitoring levels of engagement amongst other regional Australian student populations.
- There were minimal differences in student engagement by gender, suggesting that intervention programs targeting specific genders may not be required for this student cohort
- However, there were significant differences in engagement by age, with older students being more engaged with their studies. This emphasises the concept of mature-age students as a "high return on investment" population (McKenzie and Gow, 2004; Timms et al., 2018) and highlights the need for ongoing institutional support to retain this student base (Heagney and Benson, 2017). On the other hand, there should be a focus from educators to improve engagement and interactions with younger students – particularly recent school-leavers – in

order to reduce this age-based disparity. This could take the form of developing relevant material and assessments, delivered in an engaging manner that encourages critical thinking and leaves space for students' own exploration of the topic (Chan et al., 2014; Collaço, 2017; Parsons and Taylor, 2011; Zapke et al., 2009).

- Similarly, there were significant differences in engagement levels by program, with Veterinary Science students showing the least engagement. This underscores the need for educators to cater to the unique learning approaches among students from a diverse cohort (Zepke and Leach, 2010b). This could include the use of digital technologies as a "fun" way of learning (Rashid and Asghar, 2016), providing students with the rationale behind learning the content material, and using "higher" cognitive questioning during lectures (Campbell and Mayer, 2009; Redfield and Rousseau, 1981).

For further suggestions on increasing student engagement, readers are directed toward several excellent works on this topic (Chickering and Gamson, 1987; Parsons and Taylor, 2011; Webber et al., 2013; Zeeman and Lotriet, 2013; Zepke and Leach, 2010a, 2010b). While we do not claim to hold all the answers, we remind fellow educators that "teaching is an art, and requires an inventive mind" (Berliner, 1993).

Our results clearly show that it is possible to measure student engagement and the components of engagement in a diverse population of students. This allows a teacher to quantify engagement of their students, reflect on empirical evidence, and monitor the effectiveness of interventions aimed at improving student engagement. For example, the component "skills engagement", which has previously been identified as an important predictor of student success in the first year of tertiary study (Brown et al., 2017a), clearly identifies actionable data that could be used by course lecturing staff to improve student course engagement by embedding study skills within course delivery. We also show that emotional engagement can also be quantified by the SCEQ instrument and suggest that this type of engagement could be increased with more regular contact with peers and regular, meaningful contact with teaching staff. Students have previously reported that regular contact with peers was encouraging, motivational, and positively contributed to their sense of belonging (Zepke and Leach, 2010b). Also, if there is evidence that certain age groups are less likely to be engaged than others (as shown in this study), it strengthens the argument that interventions to improve engagement should be targeted at the neediest. When informed with the knowledge of their students' levels of engagement, a teacher may modify their pedagogical practices to target specific student groups to improve engagement – for example, using contextualisation, where the delivery of course content is made relevant to everyday life experiences, can promote an improved retention of material, sustain interest in the content, and increase student engagement levels. Instruction which uses contextualisation focuses the attention of learners through the presentation of relevant content within an explicit application, and using this approach, learners are more likely to recognize the relevance of this information in solving novel problems which arise in their everyday lives. Our study shows that the SCEQ instrument could be used to quantify engagement in students exposed to these interventions, and the data collected could inform evidence-based decisions regarding the effectiveness of such interventions. For example, it could be used to assess the impact of changing units from a lecture-based style to a flipped classroom structure, or using an inquiry-oriented approach in laboratory sessions.

Limitations

Although several important conclusions can be drawn from the present study, it is important to note that it has its limitations. As we only considered students from FedUni, with both campuses investigated being based in rural/regional areas, the generalisation of the results to urban or primarily urban universities should be considered with caution. Similarly, all three units in this study were predominantly delivered face-to-face. Depending on the specific content delivery styles, this could result in potential differences in student engagement compared to other universities that deliver learning resources via

distance/online mode. As highlighted by many researchers, there is considerable opportunity to use online delivery modes to provide highly engaging material that extends student learning (Baxley, 2018; Desy et al., 2018; Johnson et al., 2021; Sharma et al., 2020). The scope of this study was somewhat limited, as we only considered approximately 300 students from one year. However, we consider it highly unlikely that the attitudes and engagement of student cohorts would change significantly from year to year, in the absence of significant structural changes in the university or changes in teaching styles at a lecturer level. Furthermore, we only considered students from one general field of study (those studying science/health-related units). Although it is most likely that the results presented here are more broadly applicable across a range of fields, and such it would be prudent to conduct future studies across different disciplines to substantiate this.

In future studies, it could be beneficial to attempt correlations between student engagement and their academic achievement or retention, as several authors have previously reported correlations between student attitude toward their studies and their achievement (Ali and Awan, 2013; Brown et al., 2015; Ross et al., 2020). In particular, it would be informative to link specific aspects of student engagement to their achievement, as this would provide specific areas for unit coordinators to focus on when attempting to improve student engagement.

Conclusion

With many universities striving to improve student "engagement", it is important to consider the factors influencing engagement in order to design targeted strategies toward this end. In this study of first-year undergraduate students at a regional Australian university, student engagement was not found to vary depending on the unit being taught (i.e. content), with only minor differences found between genders for the skills engagement subscale only. Females scored significantly higher on this measure, albeit at a relatively low magnitude of difference. Student age had a larger impact, with students under 20 years of age scoring significantly less than mature age students across nearly all measures of engagement; most notably for the emotional and participation measures. The program that students were enrolled in appeared to have a large impact on student engagement, although most of the differences could be attributed to the varying age demographics of students comprising each cohort. Suggested approaches to improve student engagement, particularly for those under 20 of age, include emphasising the relevance of the unit content to students' lives and interests, increasing student-to-teacher and student-to-student interaction through the means of digital technologies and social media, and using interactive delivery approaches to lectures and tutorials.

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