

Measuring Student Engagement in an Introductory Anatomy & Physiology Course

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Abstract – Surveys which measure student engagement should be simple and convenient to use, yet robust enough to capture meaningful data. In the current study, a 10-question survey was used to measure 3 constructs of student engagement, these being cooperative learning, cognitive challenge, and personal skills. These were measured in an introductory undergraduate Human anatomy and physiology course. With 407 respondents, the internal reliability of the sub-scales was good (Cronbach alpha values ≥ 0.8). Data indicated that a large proportion of students did not engage cooperatively in the classroom by either not asking questions or not working with others. Also, more than 40% of students neither worked with classmates outside the classroom nor helped tutor classmates during class. Students (65%) reported that the course required them to be independent learners, and only 37% of students reported that they were encouraged to demonstrate the skill of working and learning effectively with other individuals. Written feedback from students indicated that engagement in educationally purposeful activities (e.g. tutorials) was one of the best aspects of the course. Measuring engagement in an introductory anatomy and physiology course can provide an early indication of the student experience.

Keywords – First Year Undergraduates; Physiology Education Research; Engagement.

I. INTRODUCTION

Non - traditional, interactive - engagement methods of teaching appear to be much more effective than traditional pedagogy [1]. The National Survey of Student Engagement (NSSE) is an ongoing research campaign in the USA used to measure the extent to which universities are participating in educational practices associated with high levels of student engagement. NSSE data focus on how students use resources for learning and examines the environment in which university students engage with their university learning [2]. Measuring student engagement provides evidence about individuals' intrinsic involvement with their learning, and how students are making use of available educational opportunities. Engagement in educationally purposeful activities is linked with undergraduate student success, whereby the quality of effort a student devotes to these activities (i.e. more engaged) the more likely there will be a positive contribution to academic achievement [3]. As the student population becomes larger and more diverse, and as the bachelor's degree becomes the passport for entry into the professional workforce, there is a growing need to understand how to engage students from enrolment through to graduation [4]. There is clearly room for improvement in this area, with around 33 out of every 100 Australasian students reporting in the 2008 Australasian Survey of Student Engagement (AUSSE) that they had 'seriously

considered' departing their institution before graduation. Ahlfeldt et al. [5] developed a simple instrument to measure student engagement at a class level. The instrument was designed to explore three characteristics about the students and was based on three groupings of questions designed to learn more about levels of cooperative learning, levels of cognitive challenge, and the development of personal skills. The aim of the current study was to use this instrument to measure student engagement in an introductory Human anatomy and physiology course. Other surveys used in this context [6, 7] reported a more complex four-factor internal structure comprising the sub-scales: 1. Study skills; 2. Performance; 3. Participation; 4. Emotional.

An introductory course in Human anatomy and physiology can provide the scaffolding for health professionals to comprehend the biological mechanisms underpinning health care practice - however, the teaching and learning of anatomy and physiology in undergraduate health science curricula have been problematic [8-10]. An increased student engagement with anatomy and physiology subjects may improve both confidence and academic performance, and possibly encourage a student to complete their studies. Increased engagement generally benefits all students, although the effects are even greater for lower ability students [11].

II. METHODS

A simplified on-line version of the instrument developed by Ahlfeldt et al. [5] was given to first year undergraduate students undertaking a compulsory course in Human anatomy and physiology. Students were invited to complete the survey during the 6th week of their first term of their first year of university study. The instrument (see figure 1) was made available as an on-line survey, accessed through the electronic course management and delivery system (Blackboard). The survey took approximately 2 min to complete, and an email reminder was sent to students to request their completion of the survey. Qualitative feedback regarding the delivery of the course was obtained through open-ended questions inviting written responses. These questions were:

1. What do you consider to be the best aspects of this paper?
2. What aspects of this paper are in most need of improvement?

Quantitative data were analysed using IBM SPSS Statistics 25, and qualitative data were analysed using 2018 Qualtrics®.

During your class, about how often have you:

1. Asked questions during class or contributed to class discussions.

None at all	A little	A moderate amount	A lot	A great deal
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2. Worked with other students on projects during class time.

None at all	A little	A moderate amount	A lot	A great deal
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3. Worked with classmates outside of class to complete assignments.

None at all	A little	A moderate amount	A lot	A great deal
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4. Tutored or taught the class materials to other students in the class.

None at all	A little	A moderate amount	A lot	A great deal
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To what extent has this course emphasized the mental activities listed below?

1. Memorizing facts, ideas, or methods from your course so you can repeat them in almost the same form.

None at all	A little	A moderate amount	A lot	A great deal
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2. Analysing the basic elements of an idea in depth and considering its components.

None at all	A little	A moderate amount	A lot	A great deal
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3. Applying theories and/or concepts to practical problems or to new situations.

None at all	A little	A moderate amount	A lot	A great deal
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To what extent has this course contributed to your knowledge, skills, and personal development in the following ways?

1. Thinking critically and/or analytically.

None at all	A little	A moderate amount	A lot	A great deal
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2. Working and learning effectively on your own.

None at all	A little	A moderate amount	A lot	A great deal
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3. Working and learning effectively with other individuals.

None at all	A little	A moderate amount	A lot	A great deal
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Fig. 1. Student engagement questionnaire. Questions in green measured cooperative learning, questions in blue measured cognitive challenge, and questions in red measured personal skills.

The survey had three sub-scales (as described in the original construction of the survey), and the internal consistencies were calculated using Cronbach's alpha for each sub-scale. This statistic has a range from 0 – 1 and indicates the degree to which item scores in a sub-scale correlate with each other and the total score. Cronbach's alpha values close to 1 (the maximum possible) suggest that the items in the sub-scale are each measuring the same construct, whereas values close to zero indicate that the items in the sub-scale are not measuring the same construct.

The sub-scales were:

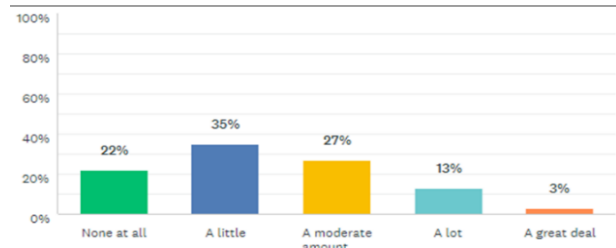
1. Cooperative learning (4 items);
2. Cognitive challenge (3 items);
3. Personal skills (3 items).

III. RESULTS

The survey had 407 respondents (1236 invited to respond, 33 % response rate). The time spent to complete the survey was 2 min. There were 437 (35% response rate) responses to the qualitative feedback questions. Cronbach's alpha values for the three sub-scales were 0.87 and 0.80, and 0.81 for Cooperative learning, Cognitive challenge, and Personal skills, respectively. These values indicated good internal reliability of the sub-scales.

During your class, about how often have you:

Asked questions during class or contributed to class discussions?



Worked with other students on projects during class time?

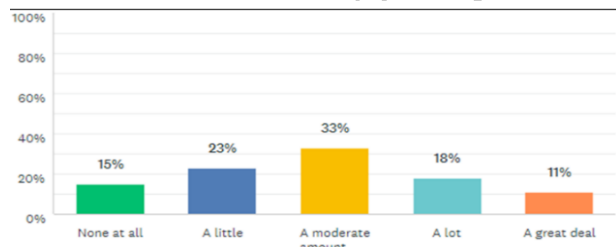
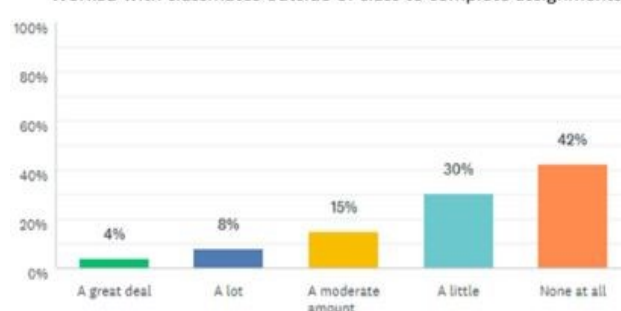


Fig. 2. Responses to questions 1 and 2 in the Cooperative learning sub-scale.

As shown in figure 2, a large proportion of students were not engaging cooperatively in the classroom by either not asking questions or not working with others. This low engagement is supported by the responses to questions 3 and 4 in the survey (data shown in figure 3) whereby more than 40% of students neither worked with classmates outside the classroom nor helped tutor classmates during class.

During your class, about how often have you:

Worked with classmates outside of class to complete assignments.



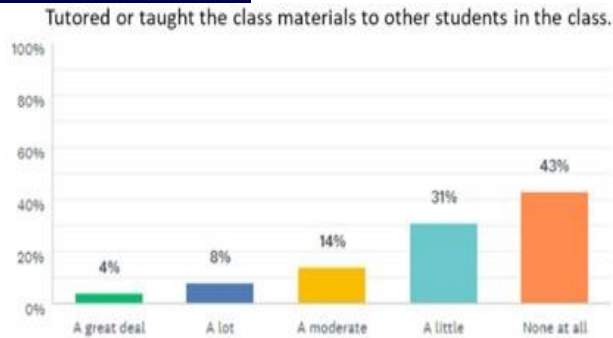


Fig. 3. Responses to questions 3 and 4 in the Cooperative learning sub-scale.

Data shown in figures 2 and 3 indicated that very few students reported as being engaged in cooperative learning to 'a great deal' with responses being only 3%, 11%, 4%, and 4%.

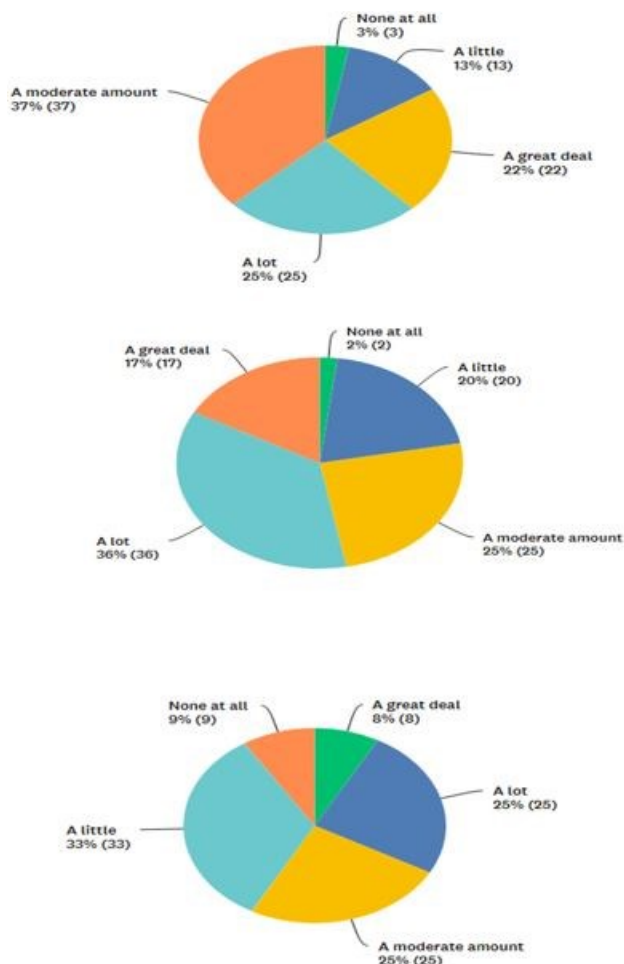


Fig. 4. Responses to the questions in the Cognitive challenge sub-scale: To what extent has this course emphasized the mental activities listed below? Q1. Memorizing facts, ideas, or methods from your course so you can repeat them in almost the same form – shown in the top chart; Q2. Analysing the basic elements of an idea in depth and considering its components – shown in the middle chart; Q3. Applying theories and / or concepts to practical problems or to new situations – shown in the bottom chart.

Data reported in figure 4 are the responses to questions which comprise the Cognitive challenge sub-scale. Nearly half of responses to the question regarding memorizing facts (Q1) were either 'a lot' (25%) or 'a great deal' (22%), and over half of the responses to the question regarding analysing the basic elements of an idea (Q2) were either 'a lot' (36%) or 'a great deal' (17%). Responses to the question regarding application of course content were centred around the mid-point of the scale with 37% at 'a moderate amount'. These findings suggest that the level of cognitive challenge in this introductory anatomy and physiology course was about right, but there was some need of improvement regarding the availability of opportunities to apply course content to practical, real-world situations.

Table 1 reports data on the responses to the 3 questions in the sub-scale 'Personal skills'. These data indicated that many students (65%) reported that the course required them to be an independent learner. While this is an important study skill, the course also encouraged personal skills for group learning, but only 37% of students reported that they were encouraged to demonstrate the skill of working and learning effectively with other individuals.

Table 1. Responses to questions in the Personal skills subscale.

	Thinking critically and/or analytically	Working and learning effectively on your own	Working and learning effectively with other individuals
A great deal	13%	33%	11%
A lot	23%	32%	26%
A moderate amount	32%	19%	30%
A little	22%	14%	20%
None at all	10%	2%	13%

The open-ended questions returned many comments regarding the structure of the course and individual student experiences of the course. Representative statements regarding positive engagement of students with the course were:

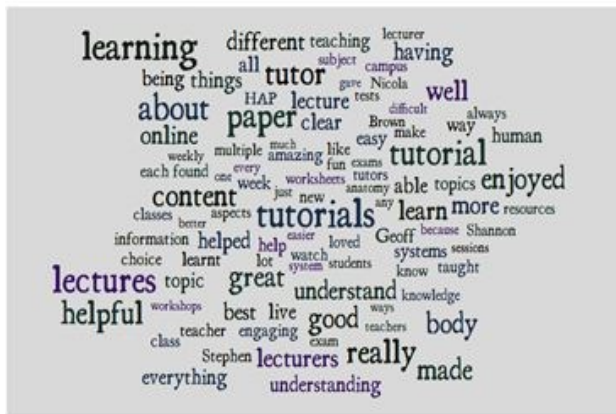
"The tutors' engagement with the class and hands-on learning was great."

"...I also engaged more with the personalised learning that comes with the tutorials."

"The learning, and the tutorials... they were interactive, engaging, and we were able to see how the body worked."

All written feedback was used to create two word-clouds, (word frequency >10, increasing size and boldness associated with increased frequency): one for "What were the best aspects of this paper?", and the other for "What aspects of this paper are in most need of improvement?". These are shown in figure 5.

What were the best aspects of this paper?



What aspects of this paper are most in need of improvement?

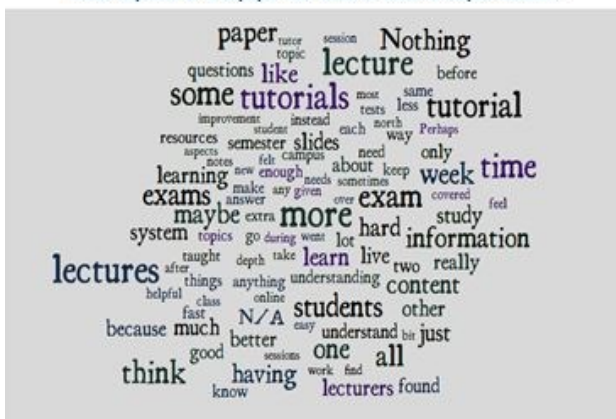


Fig. 5. Word clouds produced from student written feedback.

As shown in figure 5, the interaction with academic staff during delivery of the course generally had a positive effect on the students' experience. The delivery of tutorials was indicated to be both positive and negative, however, the negative (i.e. in most need of improvement) comments were administration issues regarding tutorial timing whereby early morning and evening tutorials were problematic for students.

IV. DISCUSSION

This study uniquely reported the use of a simplified survey to measure aspects of student engagement in a first - year introductory course in Human anatomy and physiology. The findings showed that the 10 - item questionnaire can be used to quantify three components of engagement, and each of these sub - scales had good internal consistency. Qualitative findings indicated that positive, professional relationships with academic staff helped to promote student engagement.

The relationship between student engagement and conceptual understanding of subject-matter is important, after all, practices which increase student engagement but detract from learning are counterproductive in education [12]. A limitation of the current study was that student academic grade was not collected simultaneously with the engagement data. A criterium stipulated by the Ethics

committee was that all data remained anonymous. It is necessary to develop good standardized engagement survey instruments for use in all subject areas (including anatomy and physiology), however, developing such tests is a difficult and time-consuming task. Until such tests are developed, instruments like the one used in the current study may prove useful in measuring student engagement.

Engagement with a course is beneficial to the student experience at university, however, the correlation between engagement and academic performance may be weak [6]. A student may be disengaged with the course but score well on academic tests, and equally, an engaged student may perform poorly on academic tests. This correlation may be even weaker in large multi-disciplinary cohorts studying a course in which the content may appear to be outside the core content of a named pathway (for example, undergraduate nurses studying physiology). Therefore, the need to measure course engagement is as relevant in these types of courses as it is in smaller, specific courses.

Student engagement could be increased with more regular contact with other students, and with professional contact with staff. Students have previously reported that regular contact with peers was encouraging, motivational, and positively contributed to their sense of belonging [13]. An introductory course in anatomy and physiology may well benefit from multiple and diverse opportunities to engage students in learning experiences, rather than focus on content delivery.

To be engaged with a first-year curriculum, students need to acquire the academic skills and literacies needed to be independent in their learning [14]. Introductory courses should be designed to support student engagement with learning environments through intentional integration and sequencing of knowledge [15]. The personal skills sub-scale in the survey used in the current study may capture a student's deficiencies in appropriate study skills required for meaningful engagement. It is much more likely that a student who is competent in their study skills is more likely to be an engaged learner [16]. Providing support for the attainment of study skills, and appropriate preparation programmes which help to clarify academic expectations will likely increase student engagement.

Measuring student engagement is of national importance as it provides evidence about individuals' intrinsic involvement with their learning and the extent to which they are making use of available educational opportunities. Student engagement reflects a student's involvement with activities and conditions that are likely to generate high quality learning [17], and increased engagement will contribute to positive learning outcomes. The NSSE [2] and the AUSSE [18] are examples of survey instruments which measure both academic and institutional engagement. However, the current study focussed on course engagement, and not institutional engagement. This focus is meaningful as it is the course which provides a conduit for the interaction between academic staff and students to achieve learning objectives. Also, the survey used in this study is more convenient to administer than both AUSSE and the NSSE, making it more suitable for regular and frequent use in class settings.

V. CONCLUSION

Engagement in an introductory anatomy and physiology course can provide an early indication of the student experience when studying these subjects. A simple but effective method of measuring student engagement can potentially alert an educator to a disconnect between academic achievement and understanding.

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REFERENCES

- [1] Hake, R.R. (1998) Interactive - engagement versus traditional methods: A six-thousand student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1), 64-75.
- [2] Kuh, G.D. (2001) assessing what really matters to student learning: Inside the National Survey of Student Engagement. *Change*, May - June, 10 - 66.
- [3] Kuh, G.D., Cruce, T.M., Shoup, R., Kinzie, J. (2008) Unmasking the effects of student engagement on first-year college grades and persistence. *The Journal of Higher Education*, 79(5), 540-563.
- [4] Coates, H. (2005). The value of student engagement for higher education quality assurance. *Quality in Higher Education*, 11(1), 25-36.
- [5] Ahlfeldt, S., Mehta, S., Sellnow, T. (2005) Measurement and analysis of student engagement in university classes where varying levels of PBL methods of instruction are in use. *Higher Education Research and Development*, 24(1), 5-20.
- [6] Brown, S., White, S., Bowmar, A., Power, N. (2017) Student engagement in a compulsory introductory physiology course. *Journal of the Scholarship of Teaching and Learning*, Vol. 17, No. 1, February 2017, pp. 52-62.
- [7] Handelsman, M.M., Briggs, W.L., Sullivan, N., & Towler, A. (2005) A measure of college student course engagement. *The Journal of Educational Research*, 98, 184-191.
- [8] Davies, S., Murphy, E., Jordan, S. (2000) Bioscience in the pre-registration nursing curriculum: finding the right teaching strategy. *Nurse Education Today*, 20, 123-135.
- [9] Davis, G.M. (2010) what is provided and what the registered nurse needs - bioscience learning through the pre-registration curriculum. *Nurse Education Today*, 30, 707-712.
- [10] Jordan, S. (1994) should nurses be studying bioscience? A discussion paper *Nurse Education Today*, 14(6), 417-426.
- [11] Kuh, G.D. (2008). High-impact educational practices: What they are, who has access to them, and why they matter. *Washington: Association of American Colleges and Universities*.
- [12] Hake, R.R. (2002) Lessons from the physics-education-reform effort. *Conservation Ecology*. Available online at: <http://www.consecol.org/Journal/>
- [13] Ross, C. (2008) culturally relevant peer support for Māori and Pasifika student engagement, retention and success. Ako Aotearoa, New Zealand. Available at: <https://ako.aotearoa.ac.nz/ako-aotearoa/ako-aotearoa/resources/pages/culturally-relevant-peer-support-m%C4%81ori-and-pasifika-student>
- [14] Kift, S. (2016) A Decade of Transition Pedagogy: A Quantum Leap in Conceptualising the First Year Experience. *HERDSA Review of Higher Education*, 2, 51-86.
- [15] Nelson, K., Clarke, J., Stoodley, I., & Creagh, T. (2015). Using a capability maturity model to build on the generational approach to student engagement practices. *Higher Education Research & Development*, 34 (2), 351-367.
- [16] Reason, R., Terenzini, P., & Domingo, R. (2006) First things first: Developing academic competence in the first year of college. *Research in Higher Education*, 47(2), 149-75.

- [17] Radloff, A. (2012) Student engagement in New Zealand's universities. *ACER, Melbourne Australia*. Available at: <https://ako.aotearoa.ac.nz/ako-aotearoa/student-engagement>.
- [18] Coates, H. (2010). Development of the Australasian survey of student engagement (AUSSE). *Higher Education*, 60:1-17.

AUTHOR'S PROFILE



Dr. Stephen Brown is a senior lecturer in physiology, with research interests in teaching and quantifying the student experience. Stephen is interested in the transition into higher education for science students, particularly those choosing to study the health disciplines.