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Attitude to Physiology in Undergraduate Nursing, Midwifery, and Paramedicine Students

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***Abstract* – Studying introductory human physiology is an essential part of the nursing, midwifery, and paramedicine university curriculum. Academic success is important, although attitude also contributes to an undergraduate's experience. We measured attitude to physiology using a novel semantic differential purpose-designed diagnostic instrument, in 338 midwifery, nursing, and paramedicine undergraduates studying 2 compulsory courses in human physiology. The courses were a first semester introductory course (HAP 1) and a second semester course (HAP 2). Exploratory factor analysis identified 2 components, described as affective attitude (12 items), and cognitive attitude (8 items). Component scores were not different between the nursing, midwifery, and paramedicine programmes (P>0.05, Kruskall-Wallis 1-way ANOVA). However, the affective attitude score (mean (sd)) for HAP 1 was higher than HAP 2 (4.81 (0.61) versus 4.59 (0.57), P<0.01, Mann-Whitney U test), whereas the cognitive attitude score for HAP 1 was lower than HAP 2 (3.65 (0.45) versus 3.80 (0.45), P<0.01, Mann-Whitney U test). The instrument was simple to both administer and complete, and appeared to have a suitable structure to quantify both affective and cognitive components of attitude - it may be a suitable instrument to measure the effects of curriculum changes on student attitude, and monitor students' attitude throughout a programme.**

***Keywords* – Attitude; Factor Analysis; Paramedicine; Physiology.**

I. INTRODUCTION

The experiences of undergraduates in their first year of study may underpin their academic success, potentially reinforcing their decision to embark on a career in the health professions. Nursing, midwifery, and paramedicine students all share common academic content regarding the need to understand basic human anatomy and physiology, and it is the *attitude* to this content that can influence a students' first year experience. However, a students' attitude to a subject which they are expected to study is not often quantified [1], despite higher academic achievement in a subject being consistent with a positive attitude [2 -5].

Attitude is a reflection of the tendency to respond to a given stimulus, and this response has both affective and cognitive elements, thus suggesting a distinction between an individuals' thoughts and their emotions toward the stimulus, - this has been described as forming a bipartite theoretical model of attitude [6, 7]. An affective attitude tends to reflect an individuals' emotional response to the stimulus, whereas a cognitive attitude tends to reflects an individuals' understanding and their knowledge of the stimulus [4]. Thus, attitude to a subject, for example physiology, can be both identified within this bipartite structure and be quantified within this bipartite structure, however, this requires an appropriate instrument which can identify these two elements [1]. Also, if attitude can be summarised as being either positive or negative, or on a continuum between these two, it is logical therefore, to also consider a positive or negative *cognitive* attitude, and a positive or negative *affective* attitude. Therefore, an instrument which can quantify an individuals' attitude and the underlying constructs of attitude may be a useful tool to measure the effects of novel approaches to teaching a subject such as physiology.

Bloom et al. [8] developed a classification scheme of educational objectives which included a cognitive domain (progressing from knowledge through evaluation), an affective domain (moving from receiving to characterizing), and a psychomotor domain (progressing from perception to origination) [8] – these developments were an attempt to shift education away from simply knowledge transfer and acquisition, and into higher cognition, emotions, and behaviours. An education model which develops competencies, where instruction more closely aligns with practice [9, 10], is based around an educator who attempts to align a learner's knowledge (thereby addressing a cognitive dimension), attitude (addressing an affective dimension), and skill set (thereby addressing a psychomotor dimension). Demonstrating competency in a simulated environment has been utilised in clinical education environments [11, 12], and this may address each of the three domains proposed by Bloom et al [8], although educators using simulation require appropriate skills to ensure student learning [13]. What is often missing is an evaluation of the student's attitude when these pedagogies are used in a curriculum, and this may partly be attributable to the lack of a convenient instrument to quantify attitude.

A students' attitude to a subject may also be influenced by their perception of the relevance of the subject to their chosen career ambition – this is particularly relevant when service courses (for example, introductory general anatomy and physiology courses) are delivered in the first year of a programme, as is common in many institutions. A student's early experiences at university may contribute to their academic success, and a negative attitude to a subject which is perceived to be only loosely connected to their interests, can present an education barrier. Thus, we suggest that quantifying attitude is as important as measuring academic success, and using a simple, time-efficient instrument to measure attitude may have utility.

The aim of the current study was to evaluate an instrument to measure the attitude of student's to the subject of physiology using an exploratory factor analysis approach. We hypothesised that the instrument may contain affective and cognitive sub-scales which could be

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used to quantify these components of attitude in undergraduate students. We also aimed to compare attitude scores of students on three different health science programme, namely nursing, midwifery, and paramedicine.

II. METHODS

A. Course and Setting

This study was approved by the University's Human Ethics Committee and carried out at a large publicly funded higher education institution. The University offered a new enrolment opportunity for all prospective students in both January and June, therefore many courses run simultaneously in both semester periods. Two compulsory introductory courses in Human anatomy and physiology were spread over two semesters. Human anatomy and physiology I (HAP 1) was taught to all students in their first semester of their first year of study. Passing this course was a requirement for continued progression beyond the first semester and into a second introductory course in Human anatomy and physiology (HAP 2) taught in a student's second semester of study. Students enrolled into the nursing, midwifery, and paramedicine programs all need to pass both HAP 1 and HAP 2 courses, and must complete and pass both courses to progress into further years of study.

The named health science programs offered at this University include nursing, midwifery and paramedicine. These programs typically attracted students with a diverse range of pre-university educational experiences, including both school leavers and those re-entering formal education following a period of either work or unemployment. The gender balance was considerably varied between named programs, with approximately 1:1 (female: male) for the paramedicine program, and approximately 10:1 (female: male) for the nursing program. Demographics of the students were not specifically collected for this study, as access to both student identity and confidential personal details were restricted by the Ethics Committee.

Both the HAP 1 and HAP 2 courses have a similar delivery format. Both were delivered as a weekly three hour lecture (recorded at the time of initial delivery and made available to all students for the remainder of the course), and a weekly 2 hour tutorial, over a 13 week period. A mid semester break of two weeks occurred after week 6 of timetabled lectures, and on return, a 7 week continuous period concluded with an additional two week examinations period. All lecture slides for HAP 1 could be pre-purchased by students, or were made available as downloadable power point slides (for HAP 2). Additional work sheets were supplied and used to support learning outcomes in the tutorial sessions. Two, one hour laboratory sessions were part of the HAP 1 course, these being a bone and joint dissection (bovine), and a heart and lung dissection (lamb). Two laboratory sessions were also part of the HAP 2 course, these being the determination of blood type antigens and the growth of cutaneous microbiota on culture medium. For both courses, students were strongly encouraged to purchase an introductory anatomy and physiology textbook, and although not compulsory, attendance at both lectures and tutorials was strongly encouraged.

Both the HAP 1 and HAP 2 courses were assessed by 10 weekly multiple choice tests (performed and submitted on-line), and an end-of-course 2 hour examination. In addition, HAP 1 had a mid-semester 1 hour examination carried out in just prior to the mid-semester break, and HAP 2 had a written assignment based on the first 6 weeks of lecture content which was submitted at the end of the second week after mid-semester break. All students were required to attempt all assessment tasks and to pass either course, an overall mark of 50% or greater was required.

B. Instrument Design

The Attitude to the Subject of Physiology was developed from a similar instrument used to quantify attitude to the subject of chemistry [14]. It uses the same 20 items, arranged in the same order. Adjectives and choices are placed on the same line separated by the Likert 7 point scale, and some adjective pairs are listed with the "positive" adjective on the right side while others have the "positive" adjective on the left. This is an attempt to minimize response bias. For example, if all adjective pairs are listed with the positive term on the right, respondents may fall into a pattern and not think about each item independently [14]. During the analysis, scores were reversed for items 1, 3, 6-9, 11-16, 19, and 20 (using: -1*(n – 8)). Bauer's original semantic differential instrument used in chemistry was selected over the typical alternative (for example, indicate level of agreement with a statement) in order to focus attention on a single attitude object—chemistry. We have continued with this design structure for the ASPI, where the emphasis is now placed on the single attitude object, namely physiology, and this follows some of the 'best practices' suggested by Lovelace and Brickman [15]. Bauer also used a 7 point Likert scale, as it was suggested that seven choices helped to strengthen the reliability of the instrument and take advantage of the ability of the respondents to draw distinctions – this 7 point scale has also been used in our ASPI. We also used a hard copy format of the instrument to improve the response rate as previous work during our instrument development indicated that the on-line response rate was very poor (<25%).

C. Data Collection and Analysis

As The Attitude to the Subject of Physiology Inventory (ASPI – see figure 1) was administered to students by university staff not responsible for teaching or assessing the students. Data were collected in weeks 4 and 5 of the course as this was before any major assessment, but captured all enrolled students (the late enrolment period extended to the end of week 2 of the semester). The inventory has 20 equally weighted items each assessed using a 7-point Likert scale. All students were given appropriate instruction on completing the questionnaire and were given a participant information sheet which described the background and purpose of the research. All data collected were analysed using appropriate software (IBM SPSS version 22).

An exploratory factor analysis was performed on

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questionnaire responses using the principle component analysis method with varimax rotation. Internal validity of any identified components was assessed using the Cronbach's alpha coefficient. Mean scores for identified components were calculated for each of the named programmes, and these were compared using the Kruskall-Wallis 1-way ANOVA. Scores for the affective and cognitive components were compared between the HAP 1 course and the HAP 2 course using the non-parametric Mann-Whitney U test.

Attitude to the Subject of PHYSIOLOGY Inventory (ASPI).

PLEASE IDENTIFY YOUR RESPONSE TO EACH ITEM BY CIRCLING THE NUMBER IN THE SCALE.

THE SUBJECT OF PHYSIOLOGY IS:

1.	easy	1	2	3	4	5	6	7	hard
2.	worthless	1	2	3	4	5	6	7	beneficial
3.	exciting	1	2	3	4	5	6	7	boring
4.	complicated	1	2	3	4	5	6	7	simple
5.	confusing	1	2	3	4	5	6	7	clear
6.	good	1	2	3	4	5	6	7	bad
7.	satisfying	1	2	3	4	5	6	7	frustrating
8.	scary	1	2	3	4	5	6	7	fun
9.	comprehensible	1	2	3	4	5	6	7	incomprehensible
10.	challenging	1	2	3	4	5	6	7	not challenging
11.	pleasant	1	2	3	4	5	6	7	unpleasant
12.	interesting	1	2	3	4	5	6	7	dull
13.	disgusting	1	2	3	4	5	6	7	attractive
14.	comfortable	1	2	3	4	5	6	7	uncomfortable
15.	worthwhile	1	2	3	4	5	6	7	useless
16.	work	1	2	3	4	5	6	7	play
17.	chaotic	1	2	3	4	5	6	7	organized
18.	safe	1	2	3	4	5	6	7	dangerous
19.	tense	1	2	3	4	5	6	7	relaxed
20.	insecure	1	2	3	4	5	6	7	secure

Fig. 1. Attitude to the Subject of Physiology Inventory. A 20 item semantic differential instrument used to quantify attitude in undergraduate students studying Human physiology. For analysis, scores were reversed for items 1, 3, 6-9, 11-16, 19, and 20, using: -1*(n – 8).

III. Results

Questionnaires were obtained from 338 students (>90% of enrolled students), which included 62 midwifery, 189 nursing, and 87 paramedicine students. Responses were obtained form 135 students on the HAP 1 course, and 203 on the HAP 2 course.

The Kaiser-Meyer-Olkin measure of sampling adequacy was .878 indicating that the data were suitable for the exploratory factor analysis. A two factor solution explained 46.1 % of the total variance, whereby initial Eigenvalues of 5.65 and 3.56 were calculated for components 1 and 2 respectively. Twelve items loaded onto component 1, and 8 items loaded onto component 2. Component loadings and the items which loaded onto each component are shown in table 1. The internal consistency of each identified component was determined using the Cronbach's alpha coefficient, and these scores were 0.739 and 0.746 for components 1 and 2, respectively

Component 1 has been described as "affective", and component 2 has been described as "cognitive". There were no differences in these components between the midwifery, nursing, and paramedicine programmes, as shown in figure 2, however, there were differences between the HAP 1 and the HAP 2 course, as shown in figure 3. The mean (SD) scores for the affective attitude for HAP 1 and HAP 2 were 4.81 (0.61) and 4.59 (0.57), respectively, and for the cognitive attitude for HAP 1 and HAP 2 were 3.65 (0.45) and 3.80 (0.45), respectively.

The range of academic grades for nursing, midwifery, and paramedicine students on both the HAP 1 and HAP 2 courses are comparable.

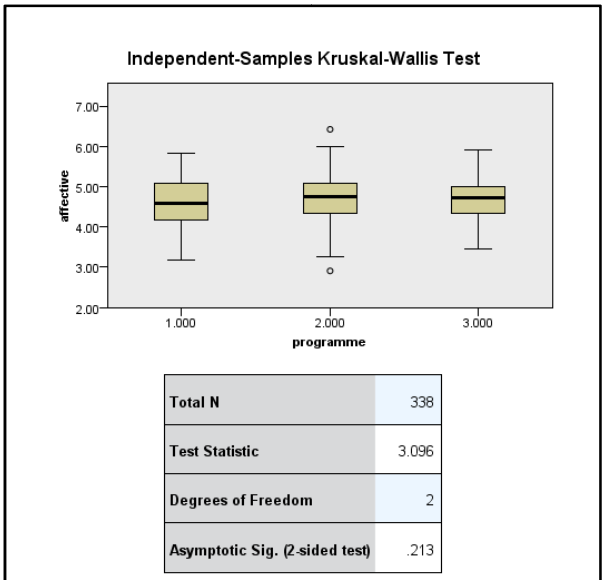

Fig. 2. Comparison of the affective attitude (upper) and cognitive attitude (lower) between programmes using a non-parametric 1-way ANOVA for multiple samples. Programme 1 - midwifery (n=62); Programme 2 - nursing (n=189); Programme 3 - paramedicine (n=87) students. Affective and cognitive scales were identified with exploratory factor analysis. Open circles denote outliers.

However, it should be noted that we were not able to match ASPI responses with students' grades as the

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collection of the ASPI responses were anonymous.

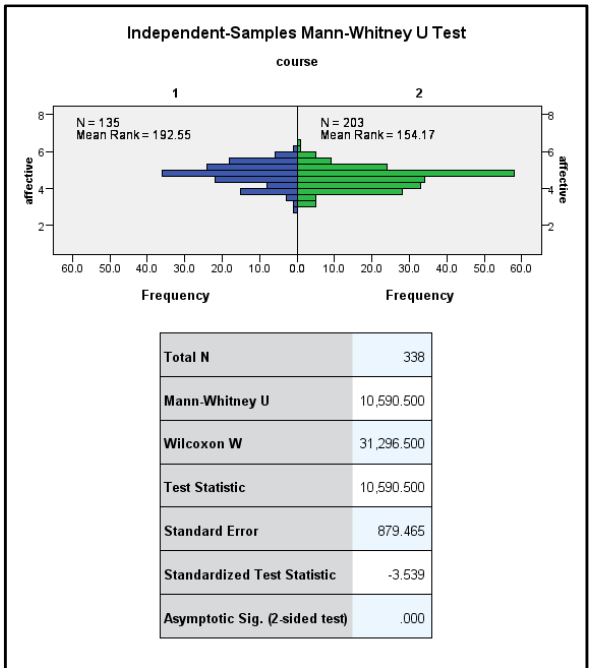
IV. Discussion

This study has used a novel instrument to quantify components of attitude in first year undergraduate courses in Human anatomy and physiology, in a group of students on programs in midwifery, nursing, and paramedicine. We have uniquely shown that when used in this population, the instrument had two latent components, which have been described as affective and cognitive, and which are consistent with the composite structure of attitude. There were no differences in the scores for each component between the chosen programs of study, but there were differences in component scores between the first semester course (HAP 1) and the second semester course (HAP 2). Our choice of instrument to quantify attitude endorses earlier work by Bauer [14] in chemistry undergraduates, and this is the first time such an instrument has been used in physiology students. Currently there is a paucity of instruments to quantify attitude to the subject of physiology in undergraduate students not majoring in physiology. Health science degrees are typically serviced by introductory courses in human anatomy and physiology, and this 'service course' needs to satisfy the diverse requirements of many degree programs while presenting physiology as a relevant and coherent subject. Measuring student attitude to physiology in this context is unique, and we suggest it may be a useful adjunct to the evaluation of the student experience.

HAP 1				Terms used in item	
Item	Component		Item		
	1	2			
α	0.739	0.746		"positive" term	"negative" term
	Component loadings		Component 1: **Affective**		
q12	.784		12	interesting	dull
q6	.764		6	good	bad
q11	.707		11	pleasant	unpleasant
q15	.703		15	worthwhile	useless
q7	.678		7	satisfying	frustrating
q14	.654		14	comfortable	uncomfortable
q13	-.624		13	disgusting	attractive
q18	.619		18	safe	dangerous
q9	.575		9	comprehensible	incomprehensible
q3	.526		3	exciting	boring
q2	-.510		2	beneficial	worthless
q17	-.466		17	organised	chaotic
			Component 2: **Cognitive**		
q19		.715	19	relaxed	tense
q10		.705	10	not challenging	challenging
q4		.684	4	complicated	simple
q5		.670	5	clear	confusing
q16		.650	16	play	work
q1		-.606	1	easy	hard
q8		.538	8	fun	scary
q20		.485	20	secure	insecure

Table 1. Component loadings for ASPI items identified during exploratory factor analysis. The extraction method was Principal Component Analysis, and the rotation method was Varimax with Kaiser Normalization (Rotation converged in 3 iterations). Component 1 has been described as "Affective" and component 2 has been described as "Cognitive".

The instrument used in this study required a respondent to express their attitude toward physiology on a scale indicated by polar adjectives – this has been described as a semantic differential tool [14]. It has been suggested that a feature of a semantic differential tool is to focus respondents to a very specific attitude object [16] – however, this is the first time this instrument has been used in this context. The description of components 1 and 2 as affective and cognitive respectively, was based on the subjective interpretation of the items which load onto each component. This was informed by the original evaluation of the instrument [14], and by the subsequent modification and production of the shortened version of the original instrument [3]. Some items identified in the affective component may appear to be more aligned with a cognitive domain (for example, comprehensible – incomprehensible), and some items identified in the cognitive component may appear to be more aligned with an affective domain (for example, relaxed – tense). The position of an item within a component is endorsed by the exploratory factor analysis, however, its overall contribution to the component is open to interpretation. We propose to use a confirmatory factor analysis in future studies to confirm the presence of these components.



Total N	338
Mann-Whitney U	10,590.500
Wilcoxon W	31,296.500
Test Statistic	10,590.500
Standard Error	879.465
Standardized Test Statistic	-3.539
Asymptotic Sig. (2-sided test)	.000

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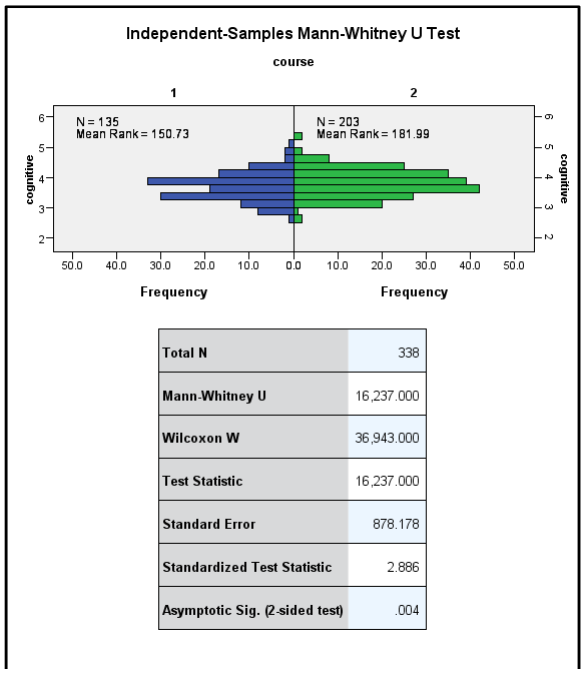

Total N	338
Mann-Whitney U	16,237.000
Wilcoxon W	36,943.000
Test Statistic	16,237.000
Standard Error	878.178
Standardized Test Statistic	2.886
Asymptotic Sig. (2-sided test)	.004

Fig. 3. Comparison of the affective attitude score (upper) and cognitive attitude score (lower) between the HAP 1 course (1) and the HAP 2 course (2). For both components, a significant ($P<0.01$) difference was found between HAP 1 and HAP 2.

In the current study, a difference between HAP 1 and HAP 2 was identified for both the cognitive and the affective components of attitude, using a non-parametric Mann-Whitney U test. The choice of a non-parametric test in preference to a parametric test was based on the arguments presented elsewhere [17], although we acknowledge this is not always practiced [18 – 21]. The differences between HAP 1 and HAP 2 suggested that students on the HAP 2 course had a lower score for affective attitude when compared to those on HAP 1. At this university, students continued to study through their first year with courses that introduced them to the clinical practice associated with their chosen program of study (for example, a nursing student assisting on a hospital ward). These work placements may have highlighted the academic focus of the Human anatomy and physiology course in contrast to the practical placements offered in other courses – this may have contributed to the more negative emotional attitude compared to the HAP 1 course. Breaking away from the practice of having only traditional didactic lectures in a first year course in physiology [22] and introducing an early clinical experience had a positive impact on student attitude to learning – however, components of attitude were not quantified. Practical experiences offer valuable learning opportunities in an undergraduate program, and we suggest the ASPI may be a suitable instrument to quantify the effect these experiences have on a student's attitude. We further speculate that regular measures of student attitudinal components is an important adjunct to the regular assessment of academic knowledge.

A higher score for cognitive attitude was recorded for the HAP 2 course compared to the HAP 1 course – this may be due to the HAP 2 course being perceived by many students as being more difficult and expecting students to understand physiological concepts in more depth. Also, as students needed to pass the HAP 1 course, all students on the HAP 2 course had already passed a course in physiology and thus were self-selected – this may partly explain the higher score for cognitive attitude. Also, there was a requirement to pass HAP 1 before enrolling into HAP 2, and a student's attitude to physiology may have become more negative as they continued to study a topic that was not their chosen program (for example, midwifery or paramedicine). University programs which require an understanding of the Human body and its physiology, such as nursing, midwifery, and paramedicine, often share common introductory courses in anatomy and physiology. These service courses may be based around core principles with their origins in biology [23, 24], however, there is no firm consensus about the content within an introductory course in physiology [25]. Students on named degree pathways which focus on health-related topics may fail to engage fully with a generalized Human anatomy and physiology course, unless the examples used to demonstrate core principles are more explicit and coherent to the discipline – this may contribute to the higher cognitive attitude scores recorded in the HAP 2 course [26]. We suggest that the ASPI could be used to regularly measure students' attitude to physiology, and therefore a course instructor may gain insight into the effects of their curriculum on their student's attitude.

V. Conclusion

It has been suggested that to achieve better learning outcomes and academic success, educators need to improve the student experience and create lifelong learning attitudes and skills in their students [27]. An important criterion for quantifying the attitude of students at university is the availability of appropriate instruments which can be used periodically throughout a program of study – we suggest that the instrument presented here may be such an instrument. Further research aimed at confirming the two component structure of the instrument is planned.

References

[1] Brown, S. J., Sharma, B. N., Wakeling, L., Naiker, M., Chandra, S., Gopalan, R. D., Bilimoria, V. B., 2014. Quantifying attitude to chemistry in students at the University of the South Pacific. Chemistry Education Research and Practice, 15(2), 184-191.

[2] Osborne, J., Simon, S., Collins, S., 2003. Attitudes towards science: A review of the literature and its implications. International Journal of Science Education 25, 1049-1079.

[3] Xu, X., Lewis, J., 2011. Refinement of a chemistry attitude measure for college students. Journal of Chemistry Education 88, 561-568.

[4] Xu, X., Southam, D., Lewis, J., 2012. Attitude toward the subject of chemistry in Australia: An ALIUS and POGIL collaboration to promote cross-national comparisons. Australian Journal of Education in Chemistry 72, 32-36.

[5] Brown, S.J., White, S., Sharma, B., Wakeling, L., Naiker, M., Chandra, S.,Gopalan, R.D., Bilimoria, V., 2015. Attitude to the study of chemistry and its relationship with achievement in an

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introductory undergraduate course. Journal of the Scholarship of Teaching and Learning, 15(2), 33-41.
[6] Bagozzi, R.P., Burnkrant, R.E., 1979. Attitude measurement and behavior change: a reconsideration of attitude organization and its relationship to behavior. Advances in Consumer Research 6, 295-302.
[7] Rosenberg, M.J., Hovland, C.I., 1960. Cognitive, Affective and Behavioural Components of Attitudes, in: Rosenberg, M.J., Hovland, C.I. (Eds.), Attitude Organization and Change: An Analysis of Consistency among Attitude Components. Yale University Press, New Haven.
[8] Bloom, B.S., Engelhart, M.D., Furst, E.J., Hill, W.H., Krathwohl, D.R., 1956. Taxonomy of Educational Objectives: the classification of Educational Goals. Handbook I: Cognitive Domain. David McKay Company, New York
[9] Rolfe, G., 1998. The theory-practice gap in nursing: from research-based practice to practitioner-based research. Journal of Advanced Nursing 28, 672–679.
[10] Ten-Cate, O., Scheele, F., 2007. Competency-based postgraduate training: can we bridge the gap between theory and clinical practice? Academic Medicine 82, 542–547.
[11] van Soren, M., Devlin-Cop, S., MacMillian, K., Baker, L., Egan-Lee, E., Reeves, S., 2011. Simulated interprofessional education: An analysis of teaching and learning. Journal of Interprofessional Care 25, 434–440.
[12] Kaakinen, J., Arwood, E., 2009. Systematic review of nursing simulation literature for use of learning theory. International Journal of Nursing Education Scholarship 1, 1–20.
[13] Topping, A., Bøje, R.B., Rekola, L., Hartvigsen, T., Prescott, S., Bland, A., Hope, A., Haho, P., Han, L., 2015. Towards identifying nurse educator competencies required for simulation-based learning: A systemized rapid review and synthesis. Nurse Education Today 35, 1108–1113.
[14] Bauer, C.F., 2008. Attitude toward chemistry: a semantic differential instrument for assessing curriculum impacts. Journal of Chemical Education 82, 1864–1870.
[15] Lovelace, M., Brickman, P., 2013. Best practices for measuring students' attitudes toward learning science. CBE-Life Sciences Education 12, 606-617.
[16] Gable, R.K., 1986. Instrument Development in the Affective Domain. Kluwer-Nijhoff Publishing, Boston.
[17] Jamieson, S., 2004. Likert scales: how to (ab) use them. Medical Education 38, 1212–8.
[18] Carifio, J., Perla, R., 2007. Ten common misunderstandings, misconceptions, persistent myths and urban legends about Likert scales and Likert response formats and their antidotes. Journal of Social Sciences 3, 106–116.
[19] Carifio, J., Perla, R., 2008. Resolving the 50-year debate around using and misusing Likert scales. Medical Education 42, 1150-1152.
[20] Norman, G., 2010. Likert scales, levels of measurement and the "laws" of statistics. Advances in Health Sciences Education 15, 625-632
[21] Sullivan, G., Artino, A., 2013. Analyzing and interpreting data from Likert-type scales. Journal of Graduate Medical Education (December), 541-542.
[22] Sathishkumar, S., Thomas, N., Tharion, E., Neelakantan, N., Vyas, R., 2007. Attitude of medical students towards Early Clinical Exposure in learning endocrine physiology. BMC Medical Education 7, 30.
[23] Michael, J., McFarland, J., Wright, A., 2008. The second Conceptual Assessment in the Biological Sciences Workshop. Advances in Physiology Education 32, 248-251.
[24] Michael, J., Modell, H., McFarland, J., Cliff, W., 2009. The "core principles" of physiology: what should students understand? Advances in Physiology Education 33, 10-16.
[25] Rathner, J.A., Hughes, D.L., Schuijer, J.A., 2013. Redesigning a core first year physiology subject in allied health to achieve better learning outcomes. International Journal of Innovations in Science and Mathematics Education 21, 37-52.
[26] Freedman, M.P., 1997. Relationships among laboratory instruction, attitude toward science, and achievement in science knowledge. Journal of Research in Science Teaching 34, 343-357.
[27] Christenson, S. L., Reschly, A. L., Wylie, C., 2012. Handbook of research on student engagement. Springer, New York.

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

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