SSLEQ-Physics: A valid survey to measure student engagement in science laboratories.

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Abstract

In science, experiments can often be used to engage students; some students engage with them, others don't. However, measuring student engagement is a challenge; research considering undergraduate physics student engagement is limited (Fredricks, 2004; Sinatra et al, 2015). The aim of this poster is to present the validation of a survey, SSLEQ (Science Student Laboratory Engagement Questionnaire), which measures students' cognitive, behavioural, and emotional engagement. The survey draws on previous works such as ASLE survey (Barrie et al, 2015) and AEQ-Physics Prac (Bhansali & Sharma, 2020) and was trialed with a sample of 304 first year physics students at three universities. Confirmatory factor analysis and descriptive statistics conducted to confirm the reliability and internal validity of the survey for the purposes of this study. The validated survey, which measures three types of engagement, is a tool that academics in other contexts can use to assess and positively influence student engagement in a laboratory course.

Introduction

Student engagement has three key dimensions (Fredricks, 2004):

Cognitive engagement underpins student learning, understanding of content and development of skills. The items associated with this are specific to the experiments such as laboratory skills, data interpretation and are called *motivators* (Barrie et al, 2015).

Behavioural engagement relate to background material and the overall course. The items associated with this are specific to support and materials such as experimental notes and demonstrators' help and are called *resources* (Barrie et al, 2015).

Emotional engagement connects positive and negative thoughts and feelings (Bhansali & Sharma, 2020). The items associated with this are specific to enjoyment, satisfaction, dullness and are called positive emotions and negative emotions.

Results: Exploratory Factor Analysis (EFA)

Analysis: The data were entered into EXCEL and analysed using SPSS. The factor analysis used a principal component analysis (PCA) method with a Varimax rotation and Kaiser Normalisation (Kaiser, 1958); the typical method in this type of study as it is considered the standard for orthogonal rotations, enforcing uncorrelated factors.

Factors and scores (λ >0.5)				
Cognitive Engagement: Motivators				
1. Data interpretation skills	.732			
2. Laboratory skills	.522			
3. Interest in experiment.	.645			
6. Increased understanding of physics	.799			
10. Relevance of experiment to discipline	.659			
12. Responsibility for own learning	.680			
Behavioural Engagement: Resources				
4. Clear assessment guidelines		.610		
5. Clear learning expectations		.543		
7. Background material		.760		
8. Demonstrators help		.625		
9. Laboratory notes		.605		
Emotional Engagement: Positive Emotions				
15. Enjoyment			.777	
16. Satisfaction			.530	
19. Excitement			.807	
20. Happy			.831	
Emotional Engagement: Negative Emotions				
21. Boredom				.682
22. Dull				.800
23. Annoy				.562
24. Resent				.626

The factors in this study satisfy all the necessary criteria, hence, a CFA can be conducted to confirm the validity of the four-factor model and structure the of the survey.

The items that were cross loaded and didn't not belong to a single category were not included in the table.

Development and trialling of the surveys

The survey, SSLEQ uses a Likert scale with the options *Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree.* The development involved cycles of implementation and validation. Data collection protocols were approved by The University of Sydney Human Ethics Committee.

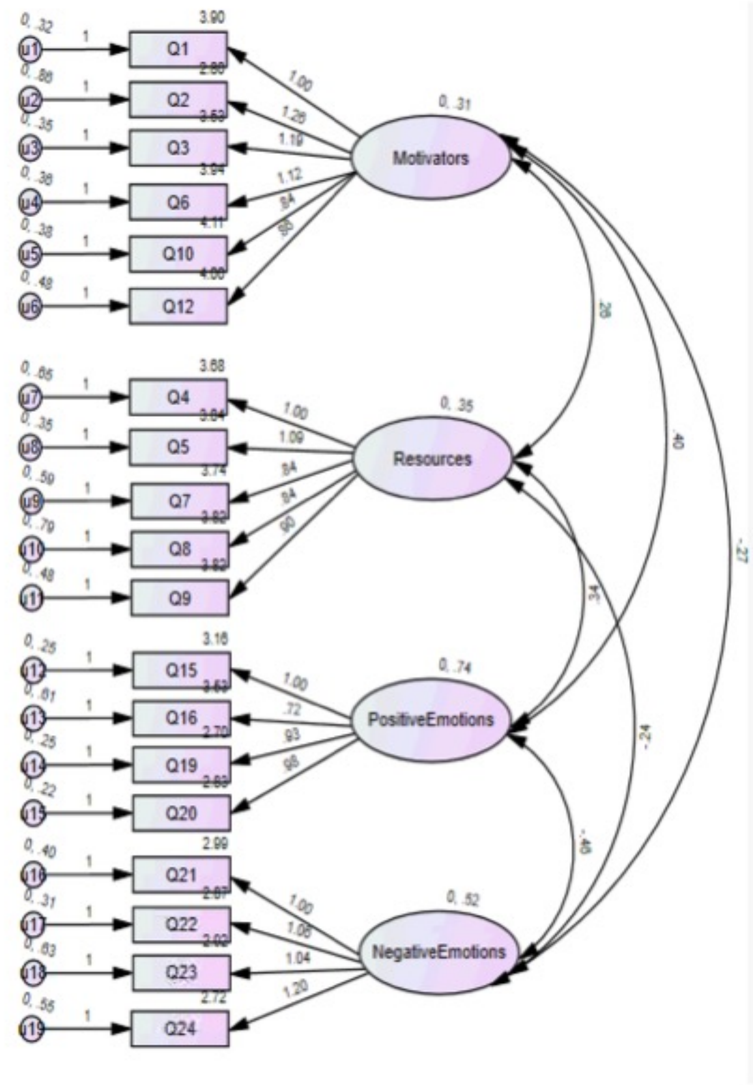
First Implementation: In 2018, the survey was trialed in an undergraduate physics experiment on standing waves, 'Waves on the rope'. 267 first-year students from the University of Sydney completed the survey. The survey had items measuring cognitive and behavioural engagement.

Second Implementation: The survey was modified. Items measuring emotional engagement were added. In 2019, the modified survey was trialed in an undergraduate experiment on uncertainty analysis, 'Bunjee Jumping'. 150 first-year students from the University of Sydney completed the survey.

Final Implementation: In 2020, the final survey (SSLEQ) was administered at the end of the semester. 864 number of students from the University of Sydney, the University of Melbourne and Monash University completed the survey.

Results: Confirmatory Factor Analysis (CFA)

The parameters and associated criteria used to assess the goodness of fit by confirmatory factor analysis using SPSS Amos.



The model contained four interrelated factors in a multi-dimensional structure. The latent factor correlations show positive relationship between the factors of the same valance and negative relationship between the emotions of opposite valence.

Discussion and Conclusion

The four factors extracted from the survey data, 'motivators', 'resources', 'positive emotions' and 'negative emotions' highlight students' cognitive, behavioural and emotional engagement in their lab experiments. The results suggest that practitioners should reflect on the experiments they offer and evaluate them with a focus on these factors. By understanding what students' perceptions are in doing experiments, the teaching can be focused on those factors and can increase student engagement.

References

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