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ABSTRACT

Evaluation of student learning strategies can be a useful way of measuring the impact of educational interventions, and provide information to educators about how best to engage students during their teaching. The Study Process Questionnaire has been widely used to evaluate student learning strategies. Students in the 2014 and 2015 year 1 cohorts of the osteopathy program at Victoria University completed the revised Study Process Questionnaire (R-SPQ-2F) as part of a larger study investigating the assessment and evaluation practices in the program. Confirmatory factor analysis was used to determine the fit of the data to the 2 factor structure of the R-SPQ-2F. Satisfactory fit was achieved through the removal of one item and the internal consistency was acceptable. This study proposes a version of the R-SPQ-2F that could be used in an Australian osteopathy student population.

INTRODUCTION

The learning strategies used by students in higher education have received substantial coverage in the literature. These learning strategies are then used to identify educational methods that may assist learners. Biggs[1] has suggested that students can broadly be classed as deep or surface learners. Deep learners are thought to engage with the subject content, reflecting on it and synthesise new with previous knowledge to develop their understanding. Surface learners on the other hand, employ strategies that allow them to retain enough information for the period of an assessment or learning activity (rote learning), but do not synthesise this with other knowledge. That said, there are examples of students employing both strategies to positive effect, particularly in clinical education.[2-4] Further, teaching style has been shown to impact on learning approach:[5, 6] teachers using primarily knowledge transmission approaches encourage surface learning; teachers using student-centred/knowledge synthesis approaches encourage deep learning.

Self-report questionnaires have been used to classify students' use of either a deep or surface approach to learning. These include the Approaches and Study Skills Inventory,[7] the Approaches to Learning at Work,[8] and the widely used Study Process Questionnaire (SPQ).[1] The SPQ was developed by Biggs et al.[1] as a way evaluating student learning strategies, and using this information as part of a quality assurance program, identify students who may need assistance, and to evaluate innovations in teaching and assessment.[9] By way of example of evaluating teaching and assessment changes, Bevan et al.[10] demonstrated that traditional lectures/examinations encouraged surface learning, whilst student-centered workshops/multiple examinations throughout a biochemistry subject encouraged deep learning. With regard to the health professions, there are numerous examples[3, 11-16] where the SPQ and it's more recent incarnation, the revised 2 factor version of the SPQ (R-SPQ-2F),[9] have been used. Interested readers are encouraged to explore the summary of learning approaches in

the context of health professions education by Newble and Entwistle.[17] The purpose of the current study was to present evidence for the validity argument for the ongoing use of the R-SPQ-2F in an Australian osteopathic student population.

METHOD

This study was approved by the Victoria University Human Research Ethics Committee.

Participants

Students enrolled in the 2014 and 2015 cohorts for year 1 of the Bachelor of Science degree in the osteopathy program at Victoria University (VU) (Melbourne, Australia) were invited to participate in a larger project evaluating the teaching, learning and assessment practices. Students were invited to complete a number of questionnaires in week 1 of the 1st teaching semester as part of their first practical skills class. Responses were anonymous and questionnaires completed on paper.

Measure

Participants completed the R-SPQ-2F and two demographic questions (age & gender). The R-SPQ-2F was developed by Biggs et al.[9] based on the original version of the SPQ, and consists of 20 items spread across 2 first order factors (deep, surface) and 4 second order factors (deep motive, deep strategy, surface motive, surface strategy). Each item is rated on a five-point Likert scale (1 = Never or only rarely true for me to 5 = Always or almost always true for me). Total scores were calculated for each first order factor. These authors[9] have reported confirmatory factor analysis (CFA) statistics supporting the factor structure of the R-SPQ-2F, however the internal consistency statistics (Cronbach's alpha) for all but the surface motive subscale are below 0.70. Other authors have demonstrated higher alpha scores (>0.80) for the deep and surface factors.[18-20]

Data analysis

Data were entered into Microsoft Excel. The *R* program[21] was used to perform the analyses. Descriptive statistics were generated, and internal consistency calculated using ordinal alpha,[22] both in the *psych* package.[23] The *lavaan* package[24] was used to perform the CFA. Robust weighted least squares (WLSMV) was used as the estimation method as the data were ordinal.[25] Multiple CFA fit statistics should be used as each has different measurement properties.[26, 27] The chi-square statistic is used to report the fit of the data to the model,[28] however there is no agreement as to the other fit statistics that should be presented. A number of authors[26, 28, 29] suggest that the comparative fit index (CFI), Tucker-Lewis index (TLI), standardised root mean square residual (RMR) and the root mean square error of approximation (RMSEA) be used. These are the fit statistics calculated in the present study and the cut scores for each statistic are presented in Table 2.

RESULTS

A total of 197 students completed the R-SPQ-2F; 83 in 2014 and 114 in 2015, representing a 69% and 88% response rate respectively. Descriptive statistics are presented in Table 1. Mean age was 19.9 (±3.2) years and 104 (53.3%) were males. Internal consistency (ordinal alpha) was 0.79 for the Deep factor and 0.79 for the Surface factor (alpha increases to 0.80 if item 8 is removed) using the R-SPQ-2F factor structure described by Biggs et al.[9]

Table 1. Descriptive statistics for the R-SPQ-2F.

	Mean	St Dev	Median	Range
Deep factor				
1. I find that at times studying gives me a feeling of deep personal satisfaction.	3.36	0.91	4	1-5
2. I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied.	3.77	0.82	4	1-5
5. I feel that virtually any topic can be highly interesting once I get into it.	3.69	1.01	4	1-5
6. I find most new topics interesting and often spend extra time trying to obtain more information about them.	3.48	0.91	4	1-5
9. I find that studying academic topics can at times be as exciting as a good novel or movie.	2.94	1.09	3	1-5
10. I test myself on important topics until I understand them completely.	3.88	0.81	4	1-5
13. I work hard at my studies because I find the material interesting.	3.86	0.79	4	1-5
14. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.	2.74	0.97	3	1-5
17. I come to most classes with questions in mind that I want answering.	2.80	0.95	3	1-5
18. I make a point of looking at most of the suggested readings that go with the lectures.	3.59	0.97	4	1-5
Surface factor				
3. My aim is to pass the course while doing as little work as possible.	1.59	0.80	1	1-4
4. I only study seriously what's given out in class or in the course outlines.	2.63	1.09	3	1-5
7. I do not find my course very interesting so I keep my work to the	1.35	0.59	1	1-5

minimum.				
8. I learn some things by rote, going over and over them until I know them by heart even if I do not understand them.	2.88	1.13	3	1-5
11. I find I can get by in most assessments by memorising key sections rather than trying to understand them.	2.17	0.87	2	1-5
12. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.	2.23	0.78	2	1-4
15. I find it is not helpful to study topics in depth. It confuses and wastes time, when all you need is a passing acquaintance with topics.	1.71	0.90	1	1-5
16. I believe that lecturers shouldn't expect students to spend significant amounts of time studying material everyone knows won't be examined.	2.33	0.98	2	1-5
19. I see no point in learning material which is not likely to be in the examination.	2.21	0.91	2	1-5
20. I find the best way to pass examinations is to try to remember answers to likely questions.	2.57	1.02	2	1-5

CFA statistics for the R-SPQ-2F are presented in Table 2. Model 1 demonstrates the fit statistics for the R-SPQ-2F proposed by Biggs.[9]

Table 2. Confirmatory factor analysis statistics.

Statistic	**Recommended value**	**R-SPQ-2F Model 1**	**R-SPQ-2F Model 2**
$\chi 2$	NA	181.92	156.09
$\chi 2$ p-value	>0.05	0.23	0.371
df	NA	169	151
$\chi 2$/df	< or = 2	1.07	1.03
Comparative fit index (CFI)	> or = 0.9	0.989	0.995
Tucker-Lewis index (TLI)	> or = 0.9	0.988	0.995
Root mean square residual (SRMR)	As close to 0 as possible	0.073	0.071
Root mean square error of approximation (RMSEA)	< or = 0.08	0.020 (CI 0.000-0.039)	0.013 (CI 0.000-0.037)

Modification indices (MI) for Model 1 suggested that item 3 *My aim is to pass the course while doing as little work as possible* would load more appropriately on the Deep factor. However, after being placed on the *Deep* factor the MI suggested it would load better on the *Surface* factor. Given the conflicting results, this item was deleted thereby producing Model 2. For Model 2, the correlation between the *Deep* and *Surface* factors was -0.38, and ordinal alpha was 0.77 for the *Surface* factor (removing question 8 did not improve the alpha score, alpha for the *Deep* factor was 0.79). Path diagrams for Model 1 and Model 2 are found at Supplementary Files 1 and 2 respectively.

DISCUSSION

The present study sought to provide evidence for the validity of the scores derived from the R-SPQ-2F in an Australian osteopathy student population. Results suggested that data from this population fits the 2 factors (*Deep* and *Surface*) with the removal of item 3 *My aim is to pass the course while doing as little work as possible*. Fit statistics and the internal consistency statistics provide evidence for the data fitting the amended model (Model 2). The internal consistency data for Model 2 is similar to that presented by other authors.[20, 30, 31]

Item 3 did not appear to fit either factor. Students typically responded with either 1 (Never or only rarely true for me) or 2 (sometimes true of me) as reflected in both the mean and median for this item. There are a number of possible explanations. Firstly, this item may not be an accurate indicator of a deep or surface learner in an osteopathy student population. Secondly, the item may require rewording as it captures two ideas within the one item (one being to pass the course, and two doing as little work as possible). Thirdly, the idea of "…doing as little work as possible" will have a different meaning between students. Given the data presented here, the removal of this item does not appear to be detrimental to the interpretation of the R-SPQ-2F. Previous research has not identified this item as being one that may need modification/removal however.

An exploration of the fit of the data to the second order factors was not undertaken, as other authors have reported that the value of the R-SPQ-2F is at item level, and at the level of the first order *Deep* and *Surface* factors.[19, 32] The negative relationship between these two factors also supports that a total score should not be calculated for the R-SPQ-2F.

Further work to investigate the relationship of the R-SPQ-2F items to aspects of the assessment programme[33] and evaluation strategy in place at VU is underway. Subsequent work will also explore the R-SPQ-2F item level data in greater detail in this population addressing the limitations in the present study.

CONCLUSION

This study provides evidence for the validity of the scores derived from the R-SPQ-2F, albeit with the removal of one item. Osteopathic educators are encouraged to perform the same work in their respective institutions to ascertain if the version of the R-SPQ-2F proposed here is suitable for their environment. The R-SPQ-2F provides a potential method by which learning strategies used by osteopathy students could be evaluated.

REFERENCES

1. Biggs JB. *Study Process Questionnaire Manual. Student Approaches to Learning and Studying*: ERIC; 1987.

2. May W, Chung E-K, Elliott D, Fisher D. The relationship between medical students' learning approaches and performance on a summative high-stakes clinical performance examination. *Med Teach* 2012;**34**:e236-e41.

3. Weller J, Henning M, Civil N, Lavery L, Boyd M, Jolly B. Approaches to learning for the ANZCA Final Examination and validation of the revised Study Process Questionnaire in specialist medical training. *Anaesth Intensive Care* 2013;**41**:631-40.

4. Van Lohuizen M, Kuks J, Van Hell E, Raat A, Cohen-Schotanus J. Learning strategies during clerkships and their effects on clinical performance. *Med Teach* 2009;**31**:e494-e9.

5. Trigwell K, Prosser M, Waterhouse F. Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Educ* 1999;**37**:57-70.

6. Prosser M, Trigwell K. Qualitative variation in approaches to university teaching and learning in large first-year classes. *Higher Educ* 2014;**67**:783-95.

7. Entwistle N, Tait H, McCune V. Patterns of response to an approaches to studying inventory across contrasting groups and contexts. *European Journal of Psychology of Education* 2000;**15**:33-48.

8. Kirby JR, Knapper CK, Evans CJ, Carty AE, Gadula C. Approaches to learning at work and workplace climate. *International Journal of Training and Development* 2003;**7**:31-52.

9. Biggs J, Kember D, Leung DY. The revised two-factor study process questionnaire: R-SPQ-2F. *Br J Educ Psychol* 2001;**71**:133-49.

10. Bevan SJ, Chan CW, Tanner JA. Diverse assessment and active student engagement sustain deep learning: A comparative study of outcomes in two parallel introductory biochemistry courses. *Biochemistry and Molecular Biology Education* 2014;**42**:474-9.

11. Gurpinar E, Kulac E, Tetik C, Akdogan I, Mamakli S. Do learning approaches of medical students affect their satisfaction with problem-based learning? *Advances in Physiology Education* 2013;**37**:85-8.

12. Kusurkar RA, Croiset G, Galindo-Garré F, Ten Cate O. Motivational profiles of medical students: Association with study effort, academic performance and exhaustion. *BMC Med Educ* 2013;**13**:87.

13. Fox RA, McManus I, Winder BC. The shortened Study Process Questionnaire: An investigation of its structure and longitudinal stability using confirmatory factor analysis. *Br J Educ Psychol* 2001;**71**:511-30.

14. Platow MJ, Mavor KI, Grace DM. On the role of discipline-related self-concept in deep and surface approaches to learning among university students. *Instructional Science* 2013;**41**:271-85.

15. Kusurkar R, Croiset G, ten Cate O. Implications of gender differences in motivation among medical students. *Med Teach* 2013;**35**:173-4.

16. Mattick K, Dennis I, Bligh J. Approaches to learning and studying in medical students: validation of a revised inventory and its relation to student characteristics and performance. *Med Educ* 2004;**38**:535-43.

17. Newble D, Entwistle N. Learning styles and approaches: implications for medical education. *Med Educ* 1986;**20**:162-75.

18. Liu ES, Carmen JY, Yeung DY. Effects of approach to learning and self-perceived overall competence on academic performance of university students. *Learning and Individual Differences* 2015;**39**:199-204.

19. Socha A, Sigler EA. Exploring and “reconciling” the factor structure for the Revised Two-factor Study Process Questionnaire. *Learning and Individual Differences* 2014;**31**:43-50.

20. Immekus JC, Imbrie P. A test and cross-validation of the revised two-factor study process questionnaire factor structure among western university students. *Educ Psychol Meas* 2009;**70**:495-510.

21. R Core Team. R: A language and environment for statistical computing. *R Foundation for Statistical Computing* [2014; www.R-project.org/.

22. Zumbo BD, Gadermann AM, Zeisser C. Ordinal versions of coefficients alpha and theta for Likert rating scales. *Journal of Modern Applied Statistical Methods* 2007;**6**:4.

23. Revelle W. psych: Procedures for Personality and Psychological Research1.4.8 ed. Evanston, Illinois, USA: Northwestern University; 2014.

24. Rosseel Y. lavaan: An R package for structural equation modeling. *J Stat Softw* 2012;**48**:1-36.

25. Muthén B, Du Toit SH, Spisic D. Robust inference using weighted least squares and quadratic estimating equations in latent variable modeling with categorical and continuous outcomes. *Psychometrika* 1997;**75**:1-45.

26. DiStefano C, Hess B. Using confirmatory factor analysis for construct validation: An empirical review. *Journal of Psychoeducational Assessment* 2005;**23**:225-41.

27. Jackson DL, Gillaspy Jr JA, Purc-Stephenson R. Reporting practices in confirmatory factor analysis: an overview and some recommendations. *Psychol Methods* 2009;**14**:6.

28. Brown TA. *Confirmatory factor analysis for applied research*: Guilford Press; 2006.

29. Schreiber JB, Nora A, Stage FK, Barlow EA, King J. Reporting structural equation modeling and confirmatory factor analysis results: A review. *Journal of Educational Research* 2006;**99**:323-38.

30. Martyn J, Terwijn R, Kek MY, Huijser H. Exploring the relationships between teaching, approaches to learning and critical thinking in a problem-based learning foundation nursing course. *Nurse Educ Today* 2014;**34**:829-35.

31. Salamonson Y, Weaver R, Chang S, Koch J, Bhathal R, Khoo C, et al. Learning approaches as predictors of academic performance in first year health and science students. *Nurse Educ Today* 2013;**33**:729-33.

32. Justicia F, Pichardo MC, Cano F, Berbén ABG, De la Fuente J. The revised two-factor study process questionnaire (R-SPQ-2F): Exploratory and confirmatory factor analyses at item level. *European Journal of Psychology of Education* 2008;**23**:355-72.

33. Vaughan B, Morrison T. Assessment in the final year clinical practicum of an Australian osteopathy program. *Int J Osteopath Med* 2015. doi:10.1016/j.ijosm.2015.04.001

AUTHOR CONTRIBUTION STATEMENT

The author developed the manuscript, undertook the data analysis and approved the final version.

ETHICAL STATEMENT

Ethics approval was obtained from the Victoria University Human Research Ethics Committee to conduct this study.

STATEMENT OF COMPETING INTERESTS

Brett Vaughan is an Editor of the International Journal of Osteopathic Medicine but was not involved in review or editorial decisions regarding this manuscript.

IMPLICATIONS FOR PRACTICE

- Evaluation of learning strategies can provide osteopathic educators with valuable information about their learners
- This study proposes a modified version of the R-SPQ-2F excluding one item that could be used in an Australian osteopathy student population
- Osteopathic educators are encouraged to explore the use of the R-SPQ-2F in their own program to ascertain if the modified version is appropriate for their context