OPEN ACCESS

ORIGINAL ARTICLE

Cross-Cultural Adaptation and Psychometric Properties of the Science Motivation Questionnaire-II: Indonesian Version

Indriasti Indah Wardhany[1], Gus Permana Subita[1], Diah Ayu Maharani[2]

[1]Department of Oral Medicine, Faculty of Dentistry, Universitas Indonesia, Indonesia.
[2]Department of Preventive and Public Health Dentistry, Faculty of Dentistry, Universitas Indonesia, Indonesia.

Author to whom correspondence should be addressed: Diah Ayu Maharani, Department of Preventive and Public Health Dentistry, Faculty of Dentistry, Universitas Indonesia, 2nd Floor, B Building, Jl. Salemba Raya No. 4, Jakarta 10430, Indonesia. Phone: +62 21 31930270. E-mail: diah.ayu64@ui.ac.id.

Abstract

Objective: To evaluate the cross-cultural adaptation and psychometric properties of the Indonesian version of students' motivation by the Science Motivation Questionnaire-II (SMQ-II). **Material and Methods:** The questionnaire was completed by fourth-year preclinical/clinical dental students who had taken oral medicine. Five components of motivation were assessed: intrinsic motivation, self-efficacy, self-determination, grade motivation, and career motivation. Intraclass Correlations (ICC) and Cronbach's alpha coefficient were used to measure internal consistency and reliability. Construct validity was analyzed using Spearman's rank correlation coefficient. **Results:** The response rate was 98.33% (419 eligible students). The ICC of 0.855 for the total score showed excellent reproducibility. Cronbach's alpha coefficient of 0.867 for the total score showed good internal consistency, and the reliability of the scale was 0.923. The partial correlation test showed that the level of lecturers' and facilitators' concern about issues during the oral medicine learning process was not a confounding factor (r=0.619; p<0.001). The construct validity using Spearman's rank correlation coefficient showed that the total SMQ-II score was significantly associated with the motivation to learn oral medicine (r=0.625; p<0.001). The discriminant validity using the Mann-Whitney U-test was significant for intrinsic motivation and self-efficacy to discriminate using the global question, and it was significant for self-determination to discriminate using oral medicine grades. **Conclusion:** This Indonesian SMQ-II version has been cross culturally adapted and has good validity and reliability.

Keywords: Validation Studies; Dentistry; Psychometrics; Motivation.

Introduction

Motivation, or an attitude that encourages people to act in a particular way, is difficult to measure because the construct contains several latent variables [1,2]. Researchers have defined motivation as the alignment of an individual's energy and drive to learn, work effectively, and achieve his or her full potential [3,4]. The importance of motivation has recently been receiving increasing attention in medical and dental education research [5-7], but this topic has long been of interest to researchers in general education [6]. A number of studies have proved that motivation is reflected in students' performance, including their cognitive, emotional, and behavioral engagement in certain activities. It is also believed that students' physical and cognitive performance will increase along with increasing motivation, which will ultimately have an impact on their learning and achievement in a domain [8-11]. Student motivation has been reported to be affected by several factors such as gender, academic achievement, and career motivation [12-14].

Motivation is often divided into intrinsic and extrinsic types. Intrinsic motivation is present when a student finds the learning activity enjoyable and interesting. By contrast, extrinsic motivation is related to the rewards earned and the punishments avoided by performing well in a learning activity [1,15]. Because motivation is understood as a series of interactions among environmental, behavioral, and personal characteristics [15], the student learning process is most effective when it adopts self-regulation as an expected learning behavior [16]. Motivation is strongly related to self-determination, which refers to students' belief that they have some control and choice in their learning activity [1,17]. Self-efficacy, which refers to students' belief that they can achieve a desired result in certain domains, also plays an important role in the learning activity [18,19].

A number of instruments have been developed to measure student motivation toward learning, such as the Motivated Strategies for Learning Questionnaire [20], the Science Motivation Questionnaire (SMQ) [21], which was initially used to assess undergraduate students' motivation in science subjects, and the Students' Motivation Towards Science Learning Questionnaire [22]. SMQ-II, which is the updated version of SMQ, is used widely and has been translated into several languages [8,23,24]. As previously noted [21], researchers can also use this questionnaire by replacing the word "science" with any subject under study [22,24].

Oral medicine is described as "a specialized discipline within dentistry that focuses on the provision of dental care for medically complex patients, and the diagnosis and management of medical disorders involving the mouth, jaws, and salivary glands" [25]. This subject is an integral part of the dental curriculum at Universitas Indonesia as well as in other countries [26]. To fulfill the minimal requirements for general dentistry as established by the Indonesian Dental Council, the oral medicine education process involves learning several prior basic and clinical dental or medical sciences, including oral pathology, oral biology, and intermediate medical sciences. The preclinical year of oral medicine study at Universitas Indonesia includes the application of active learning theory using a problem-based learning (PBL) process: laboratory practice of many sciences related to

oral disease (such as oral pathology), and oral medicine skills labs that resemble real dental clinic situations using simulated patients. Because of its complexity, oral medicine is taught in the last preclinical year of dental studies. Dental students frequently perceive oral medicine as an abstract subject and find it challenging to relate the subject taught in the preclinical year to practice. Nevertheless, during the clinical years, students are qualified to diagnose and treat oral medicine patients if they have individually performed full examinations of at least four oral medicine patients with a passing grade under individual supervision from the academic staff in the Department of Oral Medicine [27].

An oral soft tissue examination is a common activity in oral medicine that is performed during the first dental visit and in all subsequent visits [28,29]. It is not a time-consuming procedure, and simple, standard dental examination equipment is used. Because oral soft tissue lesions can range in severity from normal or mild to life threatening and can even be cancerous or precancerous [26,30], an oral clinical examination should be performed only by trained and responsible healthcare professionals. Gaining detailed knowledge and an in-depth understanding of lesions requires extensive training and experience [25,26]. At our dental school, the staff has observed that students in their clinical years often have difficulty in detecting and diagnosing oral soft tissue lesions.

Motivation plays a significant role in one's commitment to learning a certain subject. Within the discipline of oral medicine, motivation might be correlated with students' ability to detect and diagnose oral soft tissue lesions [1,8]. Nonetheless, a valid and reliable instrument to measure dental students' motivation is still limited. Therefore, this study aimed to observe the cross-cultural adaptability and psychometric properties of the Indonesian version of SMQ-II as a measurement of Indonesian dental students' motivation to learn oral medicine, as well as the impact of their motivation on learning oral medicine. It also aimed to evaluate the motivational component profiles of dental students studying oral medicine by using a validated questionnaire [21,24].

Material and Methods

Participants

SMQ-II was completed by fourth-year preclinical and clinical dental students at the Faculty of Dentistry, Universitas Indonesia. The dentistry preclinical years at Universitas Indonesia consist of four years followed by two clinical years.

The fourth-year preclinical dental students included in this study had already taken oral medicine as an integrated subject during that academic year, and they had already been graded on their examination of at least one oral medicine patient. The students did not receive extra credit or compensation for participating in the study, but they were informed that their participation would help improve strategies to enhance learning in oral medicine. Their final performance grade, in either their preclinical or their clinical year, recorded in the oral medicine course was also used as a variable in the study.

Data Collection

All participants completed the Indonesian version of SMQ-II, which was originally developed in English and the backward translation was authorized by the author [24]. This questionnaire contains five questions that each have five components of motivation: intrinsic motivation (questions 1, 3, 12, 17, and 19); self-efficacy (questions 9, 14, 15, 18, and 21); self-determination (questions 5, 6, 11, 16, and 22); grade motivation (questions 2, 4, 8, 20, and 24); and career motivation (questions 7, 10, 13, 23, and 25). Answers are given on a five-point Likert scale (0 = never; 1 = rarely; 2 = sometimes; 3 = often; 4 = always); thus, the possible total score, representing the sum of all answers, ranges between 0 and 100. Similarly, the score for each domain of MQ-II is calculated as the sum of the answers to the five questions within that domain. Additionally, two questions were included regarding the level of content expertise and students' belief that the level of content expertise and tutors' concern for effective instruction in oral medicine might interfere with construct validity as confounding factors. This was based on previous literature that described the important role of tutors/facilitators in PBL, which is to encourage and motivate students during a problem-solving group discussion [31-33].

Because the instrument can be readily adapted to specific disciplines by replacing the word "science" in each item with the name of the discipline of interest [16], we replaced "science" with "oral medicine" throughout the questionnaire. As SMQ-II was administered in native Indonesian, a back-translation process was used according to the guidelines of translation for the cross-cultural adaptation process [34,35]. In addition, the instrument was assessed by a panel of experts who volunteered to ensure that the items were clearly worded and contained no ambiguous declarative statements. The panel of experts agreed to change the word "project" to "assignment" because the term "project" is not familiar in Indonesian. They also ensured that the items were representative of the target subject. The panel of experts consisted of oral medicine professionals with 30, 10, and 5 years of experience in oral medicine education.

As a pilot study, 25 students randomly selected as representative of the present study's participants were asked to complete the Indonesian version of SMQ-II following its review by the oral medicine experts and to comment on each item, after which they participated in a group discussion. This pilot study was used to analyze the test and retest reliability. The finalized questionnaire was self-administered using Google Forms, with each student limited to one attempt. Permission to use the questionnaire was obtained via the SMQ-II website hosted by the University of Georgia at http://www.coe.uga.edu/smq/ [24].

Data Analysis

To measure internal consistency and reliability it was used a set of scores (Intraclass Correlations (ICCs) and Cronbach's alpha coefficient. Construct validity was analyzed using Spearman's rank correlation coefficient. The Mann-Whitney U-test was used to determine whether

the SMQ-II items could discriminate between those who were learning oral medicine effectively and those who were struggling in the course.

Ethical Aspects

The study was approved by the Ethics and Research Committee of the Faculty of Dentistry (No. 25/Ethical Approval/FKGUI/IV/2017). All participants provided informed consent.

Results

Of the 433 clinical students enrolled in their fourth preclinical year and clinical years at the time of the study, 14 were excluded because they had not yet examined any oral medicine patients. Of the 419 eligible students, 412 provided informed consent and completed the questionnaire, with a response rate of 98.3%. Face validity and test-retest reliability were verified with the 25 students who participated in the pilot study. For the five components of motivation, the intraclass correlations (ICCs) were 0.817 for intrinsic motivation, 0.761 for self-efficacy, 0.864 for self-determination, 0.764 for grade motivation, and 0.875 for career motivation. The total ICC score was 0.855. These results indicated excellent reproducibility. Cronbach's alpha coefficient for the total score was 0.867, indicating good internal consistency. Table 1 shows the sociodemographics and characteristics of the student sample; most were female (87.1%) aged between 21 and 23 years.

Table 1. Sociodemographics and characteristics of the student sample (n = 412).

Variables	N (%)	Mean (SD)
Gender		
Female	359 (87.1)	
Male	53 (12.9)	
Age (in Years)		
19 to 28		22.58 (±1.60)
Study Year		
4th year preclinical	107 (26.0)	
Clinical years	305 (74.0)	

The reliability of the scale was 0.923, as determined by Cronbach's alpha coefficient. The mean score and internal consistency for all questions and each component of motivation are shown in Table 2.

Table 2. Item characteristics and reliability analysis for each motivation component.

Characteristics	Mean	SD	Cronbach's alpha
Total Score	2.670	0.459	0.923
Intrinsic Motivation	2.462	0.553	0.781
Self-Efficacy	2.379	0.599	0.847
Self-Determination	2.755	0.564	0.826
Grade Motivation	2.904	0.604	0.792
Career Motivation	2.832	0.631	0.852

The panel of experts who reviewed the questionnaire before its administration indicated their belief that the level of content expertise and tutors' concern for effective instruction in oral medicine might interfere with construct validity as confounding factors. To ensure that these items were not confounding factors, a partial correlation test was conducted to examine the correlation between answers (on a five-point Likert scale) to the question "I am motivated to learn oral medicine" and SMQ-II total score, while controlling for the level of content expertise and tutors' concern. The partial correlation test showed that the level of content expertise and tutors' concern about issues arising during the oral medicine learning process was not a confounding factor (r = 0.619; p = 0.00). Construct validity was analyzed using Spearman's rank correlation coefficient. The analysis showed that the SMQ-II total score was significantly associated with motivation to learn oral medicine (r = 0.625; p = 0.00).

The Mann-Whitney U-test was used to determine whether the SMQ-II items could discriminate between those who were learning oral medicine effectively and those who were struggling in the course. All participants were asked to answer either "yes" or "no" to the following question: "I have a good grade in oral medicine." In addition, the actual oral medicine grades of all students were recorded and classified as either passing or failing. As shown in Table 3, intrinsic motivation and self-efficacy were significant discriminants with regard to the above-mentioned question, and self-determination was a significant discriminant with regard to actual grades. The mean factor-based scale score in Table 4 shows that grade motivation has the highest scores in motivating students to learn oral medicine.

Table 3. Discriminant validity of Science Motivation Questionnaire-II.

Characteristics	Median (min-max)	Good Grade in Oral Medicine p-value*	Oral Medicine Grades p-value*
Total Score	2.64 (1.0-4.0)	0.063	0.104
Intrinsic Motivation	2.40 (0.4-4.0)	0.005	0.546
Self-Efficacy	2.40 (0.4-4.0)	0.000	0.275
Self-Determination	2.80 (1.0-4.0)	0.684	0.026
Grade Motivation	3.00 (0.8-4.0)	0.150	0.402
Career Motivation	2.80 (1.0-4.0)	0.931	0.259

*Measured by the Mann-Whitney U-test.

Table 4. Descriptive statistics of SMQ-II scales (min = 0, max = 20; n = 412).

Characteristics	Mean	SD
Intrinsic Motivation	12.31	2.77
Self-Efficacy	11.90	2.99
Self-Determination	13.78	2.82
Grade Motivation	14.52	3.02
Career Motivation	14.16	3.15

Discussion

This study documented the cross-cultural adaptation and psychometric properties of the Indonesian version of SMQ-II and validated its use in measuring Indonesian dental students'

motivation to learn oral medicine. A pretest was conducted with a small group representing the real study population to identify potential problems with the questionnaire's content, including any unfamiliar terms, sentences that could be misinterpreted, and overall clarity of the questionnaire. The results with the main population showed that this version has excellent reproducibility for the total score and for each of the five components of motivation measured, with good internal consistency. The results also showed semantic equivalence between the English and Indonesian SMQ-II versions. The analysis of the study population demonstrated that the group was predominantly female, and this is consistent with the proportion of the overall student body in the Faculty of Dentistry at Universitas Indonesia [36]. The age of the population was consistent with the average age of Indonesian university students in their fourth to sixth year.

The SMQ-II psychometric properties were satisfactory and provided strong support for the scale's reliability and validity. Internal consistency was excellent, as shown by the Cronbach's alpha coefficient of 0.923 for the overall questionnaire.

The partial correlation test showed that the level of content expertise and tutors' concern for effective education was not a confounding factor to student motivation. This might be explained by the debatable tutor's and content expertise role in the PBL process [37]. Nonetheless, other studies showed that the tutor's content expertise has certain strategies that effectively meet the PBL goal, which was measured by the learning outcome [38]. Enhancing the content expertise and the tutor's role might improve a student's academic performance because students' motivation partly resulted from their perception of the classroom atmosphere, which connects directly to a teacher's encouraging attitude [38,39].

The total SMQ-II score was significantly associated with motivation to learn oral medicine. These results indicated that the items on the SMQ-II Indonesian version could adequately measure aspects of motivation.

The discriminant validity test found that the total SMQ-II score could not discriminate between those who reported having good grades in oral medicine and those who did not. However, the components of intrinsic motivation and self-efficacy could discriminate between these groups of students. This result is consistent with the theory that intrinsic motivation is reflected in a student's willingness to study hard and pursue a specialty [40-44]. The self-determination component of SMQ-II discriminated between passing and failing students. This finding is consistent with the self-determination theory: those who have a genuine interest in a subject also have a higher level of self-determination, which could lead to better performance [40-43].

SMQ-II, which is the updated version of SMQ, is used widely and has been translated into several languages, including Spanish, Greek, Chinese, Dutch, German, Japanese, Korean, Russian, and Turkish [8,23,24]. The questionnaire has also been applied in numerous subjects, including science and non-science subjects [2,8,13,14,23,45]. Regarding these facts, the importance of having a validated Indonesian version of SMQ-II is so that other subjects can use this questionnaire to measure student motivation to learn the subject; it also enables global comparisons of SMQ-II studies.

Conclusion

The results of this study cannot be immediately generalized to the general population of Indonesia's dental students, because it was based only on students from Universitas Indonesia. However, the successful cross-cultural adaptation of the Indonesian SMQ-II version with acceptable validity and reliability permits us to further explore the overall motivation of Indonesian dental students to learn oral medicine, the relationship between their motivation and study outcomes, and the influence of motivation on long-term learning, as has been done in other areas of medical education.

References

1. Ormrod JE, Anderman EM, Anderman L. Educational Psychology: Developing Learners. 9th. ed. London: Pearson Education Limited, 2017.

2. Andressa H, Mavrikaki E, Dermitzaki I. Adaptation of the students' motivation towards science learning questionnaire to measure Greek students' motivation towards biology learning. Int J Biol Educ 2015; 4(2):78-93. doi: 10.20876/ijobed.16761.

3. Martin AJ. Examining a multidimensional model of student motivation and engagement using a construct validation approach. J Educ Psychol 2007; 77(2):413-40. doi: 10.1348/000709906X118036.

4. Martin AJ. Building Classroom Success: Eliminating Academic Fear and Failure. London: Continuum, 2010. 240p.

5. White CB, Gruppen LD, Fantone JC. Self-Regulated Learning in Medical Education. In: Swanwick T. Understanding Medical Education: Evidence, Theory and Practice. London: Wiley / Association for the Study of Medical Education, 2010. Chapter 15, p. 271-282.

6. Kusurkar RA, Ten Cate TJ, van Asperen M, Croiset G. Motivation as an independent and a dependent variable in medical education: A review the literature. Med Teach 2011; 33(5):242-62. doi: 10.3109/0142159X.2011.558539.

7. Knevel RJM, Gussy MG, Farmer J, Karimi L. Nepalese dental hygiene and dental students' career choice motivation and plans after graduation: A descriptive cross sectional comparison. BMC Med Educ 2015; 15(1):219. doi: 10.1186/s12909-015-0500-5.

8. Campos-Sánchez A, López-Núñez JA, Carriel V, Martín-Piedra MÁ, Sola T, Alaminos M. Motivational component profiles in university students learning histology: A comparative study between genders and different health science curricula. BMC Med Educ 2014; 14(1):46. doi: 10.1186/1472-6920-14-46.

9. Fredricks JA, Bumenfeld PC, Paris A. School engagement. Potential of the concept, state of the evidence. Rev Educ Res 2004; 74(1):59-109. doi: 10.3102/00346543074001059.

10. Ladd GW, Dinella LM. Continuity and change in early school engagement: Predictive of children's achievement trajectories from first to eighth grade?. J Educ Psychol 2009; 101(1):190-206. doi: 10.1037/a0013153.

11. Lee JQ, McInerney DM, Liem GA, Ortiga YP. The relationship between future goals and achievement goal orientations: An intrinsic-extrinsic motivation perspective. Contemp Educ Psychol 2010; 35(4):264-79. doi: 10.1016/j.cedpsych.2010.04.004.

12. Heiligers PJM. Gender differences in medical students' motives and career choice. BMC Med Educ 2012; 12(1):82. doi: 10.1186/1472-6920-12-82.

13. Sevinç B, Özmen H, Yiğit N. Investigation of primary students' motivation levels towards science learning. Sci Educ Int 2011; 22(3):218-32. doi: 10.1007/s11274-015-1903-5.

14. Zeyer A. Motivation to learn science and cognitive style. Eur J Math Sci Technol Educ 2010; 6(2):123-30. doi: 10.12973/ejmste/75233.

15. Bryan RR, Glynn SM, Kittleson JM. Motivation, achievement, and advanced placement intent of high school students learning science. Sci Edu 2011; 95(6):1049-65. doi: 10.1002/sce.20462.

16. Glynn SM, Brickman P, Armstrong N, Taasoobshirazi G. Science motivation questionnaire II: Validation with science majors and nonscience majors. J Res Sci Teach 2011; 48(10):1159-76. doi: 10.1002/tea.20442.

17. Black AE, Deci EL. The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. Sci Edu 2000; 84(6):740-56. doi: 10.1002/1098-237X(200011)84:6<740::AID-SCE4>3.0.CO;2-3.

18. Baldwin J, Ebert-May D, Burns D. The development of a college biology self-efficacy instrument for non-majors. Sci Edu 1999; 83(4):397-408.

19. Lawson AE, Banks DL, Logvin M. Self-efficacy, reasoning ability, and achievement in college biology. J Res Sci Teach 2007; 44(5):706-24. doi: 10.1002/tea.20172.

20. Pintrich PR, Smith DAF, Garcia T, Mckeachie WJ. Reliability and predictive validity of the motivated strategies for learning questionnaire [MSLQ]. Educ Psychol Meas 1993; 53(3):801. doi: 10.1177/0013164493053003024.

21. Glynn SM, Taasoobshirazi G, Brickman P. Science motivation questionnaire: Construct validation with nonscience majors. J Res Sci Teach 2009; 46(2):127-46. doi: 10.1002/tea.20267.

22. Tuan HL, Chin CC, Shieh SH. The development of a questionnaire to measure students' motivation towards science learning. Int J Sci Educ 2005; 27(6):639-54. doi: 10.1080/0950069042000323737.

23. Saltaa K, Koulougliotis D. Assessing motivation to learn chemistry: Adaptation and validation of Science Motivation Questionnaire II with Greek secondary school students. Chem Educ Res Pract 2015; 16(2):237-50. doi: 10.1080/0950069042000323737.

24. University of Georgia: Science Motivation Questionnaire II. Available at: https://coe.uga.edu/assets/downloads/mse/smqii-glynn.pdf. [Accessed May 16, 2017].

25. Glick M, Greenberg MS, Jontell M, Ship JA. Introduction to Oral Medicine and Oral Diagnosis: Evaluation of the Dental Patient in Burket's Oral Medicine. 12th. ed. USA: People's Medical Publishing House, 2012.

26. Ali MA, Joseph BK, Sundaram DB. Dental students' ability to detect and diagnose oral mucosal lesions. J Dent Educ 2015; 79(2):140-5.

27. Ariani N, Mursid S, Odang RW, Sukotjo C, Kusdhany LS. Indonesian undergraduate dental student' perception toward implant treatment and education. J Investig Clin Dent 2013; 4(2):107-12. doi: 10.1111/j.2041-1626.2012.00166.x.

28. Rethman MP, Carpenter W, Cohen EE, Epstein J, Evans CA, Flaitz CM, et al. Evidence-based clinical recommendations regarding screening for oral squamous cell carcinomas. J Am Dent Assoc 2010; 141(5):509-20. doi: 10.14219/jada.archive.2010.0223.

29. Mignogna MD, Fedele S. Oral cancer screening: 5 minutes to save a life. Lancet 2005; 365(9475):1905-6. doi: 10.1016/S0140-6736(05)66635-4.

30. Kondori I, Mottin RW, Laskin DM. Accuracy of dentists in the clinical diagnosis of oral lesions. Quintessence Int 2011; 42(7):575-7.

31. Schmidt HG, Rotgans JI, Yew EHJ. The process of problem-based learning: What works and why. Med Educ 2011; 45(8):792-806. doi: 10.1111/j.1365-2923.2011.04035.x.

32. Maudsley G. Roles and responsibilities of the problem-based learning tutor in the undergraduate medical curriculum. BMJ 1999; 318(7184):657-61.

33. Hmelo-Silver CE. Problem-based learning: What and how do students learn? Educ Psychol Rev 2004; 16(3):235-66. doi: 10.1023/B:EDPR.0000034022.16470.f3.

34. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: Literature review and proposed guidelines. J Clin Epidemiol 1993; 46(12):1417-32. doi: 10.1016/0895-4356(93)90142-N.

35. van Widenfelt BM, Treffers PD, de Beurs E, Siebelink BM, Koudijs E. Translation and cross-cultural adaptation of assessment instruments used in psychological research with children and families. Clin Child Fam Psychol Rev 2005; 8(2):135-47. doi: 10.1007/s10567-005-4752-1.

36. Leary H, Walker A, Shelton BE, Fitt MH. Exploring the relationships between tutor background, tutor training and student learning: A problem based learning meta-analysis. Interdisc J Problem-based Learn 2013; 7(1):40-66. doi: 10.7771/1541-5015.1331.

37. Hmelo-Silver CE, Barrows HS. Goals and strategies of a problem-based learning facilitator Interdisc J Problem-based Learn 2006; 1(1):21-39. doi: 10.7771/1541-5015.1004.

38. Richardson M, Abraham C. Psychological correlates of university students' academic performance: A systematic review and meta-analysis. Psychol Bull 2012; 138(2):353-87. doi: 10.1037/a0026838.

39. Maulana R, Opdenakker MC, Bosker R. Teacher-student interpersonal relationships do change and affect academic motivation: A multilevel growth curve modelling. Brit J Educ Psychol 2013; 84(Pt 3):459-82. doi: 10.1111/bjep.12031.

40. Ryan RM, Deci EL. Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemp Educ Psychol 2000; 25(1):54-67. doi: 10.1006/ceps.1999.1020.

41. Vansteenkiste M, Sierens E, Soenens B, Luyckx K, Len W. Motivational profiles from a self-determination perspective: The quality of motivation matters. J Educ Psychol 2009; 101(3):671-88. doi: 10.1037/a0015083.

42. Vansteenkiste M, Lens W, Deci EL. Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. Educ Psychol 2006; 41(1):19-31. doi: 10.1207/s15326985ep4101_4.

43. Kursurkar RA, Croiset G, Galindo-Garre F, Cate OT. Motivational profiles of medical students: Association with study effort, academic performance and exhaustion. BMC Med Educ 2013; 13(1):87. doi: 10.1186/1472-6920-13-87.

44. Kusurkar RA, Ten Cate TJ, Vos CM, Westers P, Croiset G. How motivation affects academic performance: A structural equation modelling analysis. Adv Health Sci Educ Theory Pract 2013; 18(1):57-69. doi: 10.1007/s10459-012-9354-3.

45. Yeoh MP, Ierardi E. Motivation and achievement of Malaysian students in studying matriculation biology. Int J Adv Res 2015; 3(11):966-78.