Journal of Taibah University Medical Sciences (2015) 10(1), 21–25

Taibah University

Journal of Taibah University Medical Sciences

www.sciencedirect.com

Educational Article

Acquisition of knowledge, generic skills and attitudes through problem-based learning: Student perspectives in a hybrid curriculum

S. Hande, PhD [a,*], C.A. Mohammed, PhD [a] and R. Komattil, MD [b]

[a] *Melaka Manipal Medical College, Manipal University, Udupi, India*
[b] *Manipal University, Manipal, Karnataka, India*

Received 19 November 2013; revised 31 December 2013; accepted 2 January 2014; Available online 6 September 2014

الملخص

أهداف البحث: التحقق من تصورات الطلاب عن التعليم القائم على حل المشكلات في اكتساب المعارف،والمهاراتالعامة،والسلوك ذات الصلة،التي تعد المكونات الأساسية للمناهج الجامعية الطبيةالهجينة.

طرق البحث: تم تسجيل ٤٦٤ طالبا جامعيا بكلية الطب لأربع دفعات متتالية (اثنان في السنة الأولى، واثنان في السنة الثانية من برنامج كلية الطب) في كلية ملقا مانيبال الطبية، وأدرجوا في هذه الدراسة المستعرضة. استخدمت الدراسة استبانة مسبقة التوثيق تتكون من ١٥ فقرة صنفت إلى ثلاثة مجالات تهتم باكتساب المعرفة، والمهارات العامة والسلوك، وكانت إجابة الطلاب حسب مقياس ليكرت من خمس نقاط.

النتائج: حسن التعليم القائم على حل المشكلات اكتساب الطلاب للمعرفة والمهارات العامة والسلوك، مع علاقة إيجابية (٠,٤٥١-٠,٧٢) بين جميع المجالات الثلاثة. إن التعليم القائم على حل المشكلات أثر على الكفاءة النموذجية في المجالات الشخصية والمعرفية وأيضا بالمهارات المتعلقة بالعمل التي تعتبر مهمة للنجاح في الممارسة المهنية.

الاستنتاجات: إن التعليم القائم على حل المشكلات في مجموعات صغيرة، قدم للطلاب البيئة المفضلة والآمنة المواتية لتطوير المهارات والمواقف المطلوبة. هذه الدراسة لا تملء فجوة فقط ولكن أيضا تظهر مزايا التعليم القائم على حل المشكلات كما يراها الطلاب في المناهج الطبية المختلفة.

الكلمات المفتاحية: المناهج الهجينة; المعارف والمهارات والسلوك; طلاب الطب; التعليم القائم على حل المشكلات; تصورات الطلاب

Abstract

Objective: To investigate students' perceptions of problem-based learning in the acquisition of relevant knowledge, generic skills and attitudes in a setting where this is a vital component of the medical undergraduate hybrid curriculum.

Methods: 464 undergraduate medical students in four consecutive batches (two in the first year and two in the second year of the medicine programme) at Melaka Manipal Medical College were enrolled in this cross-sectional study. A pre-validated questionnaire with 15 items classified into three domains addressing acquisition of knowledge, generic skills and attitudes was developed and administered to all students, who responded on a five-point Likert scale.

Results: Problem-based learning improved the students' acquisition of knowledge, generic skills and attitudes, with positive correlations (0.451–0.72) between scores in all three domains. Problem-based learning affected not only typical competence in interpersonal and cognitive domains but also more general work-related skills considered important for success in professional practice.

Conclusions: Problem-based learning in small groups provided students with a favourable, safe environment for developing the necessary skills and attitudes. This study not only fills a gap but also shows the advantages of problem-based learning as perceived by students in a hybrid medical curriculum.

Keywords: Hybrid curriculum; Knowledge; Medical students; Problem-based learning; Skills and attitudes; Student perceptions

* Corresponding address: Professor of Histology, Melaka Manipal Medical College, Manipal University, Manipal 576104, Udupi, Karnataka, India.
E-mail: shyamalahande@yahoo.com (S. Hande)

Peer review under responsibility of Taibah University.

ELSEVIER Production and hosting by Elsevier

 http://dx.doi.org/10.1016/j.jtumed.2014.01.008

Introduction

Problem-based learning is one of the most important developments in health education. This educational strategy uses real problems as a context for students to learn and has been chosen for curriculum delivery in many professional schools around the world. The activities are designed to teach not only content but also skills and generic competence. The Bachelor of Medicine and Bachelor of Surgery course at Melaka Manipal Medical College is conducted in two phases: basic sciences are taught in the first year at Manipal Campus, India, and clinical training is provided in the second phase at Melaka Campus, Malaysia. Problem-based learning was incorporated in 2006 during curricular reform, when didactic lectures were reduced by 30% and problem-based learning and other small-group learning methods were introduced, on the underlying assumption that these methods would facilitate the acquisition of relevant knowledge, skills and attitudes by the students.

Generic skills and attitudes are now widely accepted as important outcomes of a university education and are being written into virtually every curriculum. Reports in the literature suggest that this approach contributes to the acquisition of not only knowledge but also generic competence and personal skills, such as problem-solving, communication and teamwork, which are essential for all graduates of higher education.[1–3] After 6 years of experience with the hybrid problem-based learning curriculum, we decided to assess its effects on acquisition of knowledge, skills and attitudes. The aim of this study was to investigate the extent to which students had taken advantage of the approach to improve their knowledge, generic skills and attitude. Specifically, we investigated students' perceptions of their acquisition of these attributes, the effect of duration of exposure to problem-based learning and whether gender affected perceptions of the desired effects of problem-based learning.

Materials and Methods

We enrolled 464 undergraduate medical students in four consecutive batches (two in the first year and two in the second year of a Bachelor of Medicine and Bachelor of Surgery degree) at the Melaka Manipal Medical College, Manipal Campus in this cross-sectional study.

A peer-validated, structured questionnaire containing 15 items classified in three domains—acquisition of knowledge, generic skills and attitudes—was developed and administered to the students. The questionnaire was pre-validated by testing it in two small problem-based learning groups. Students rated items on a scale of 1 (strongly disagree)–5 (strongly agree) on a five-point Likert rating scale. For all items, the scale was dichotomised into "strongly agree" and "agree" responses to one category, and all other responses to a second category in order to determine the overall positive effect. The results were analysed with the statistical software package SPSS version 11.5.

Principal components analysis was used to explore domain-specific assumptions distributed over the 15 items of the questionnaire in order to categorise them into the three domains of knowledge, attitude and skills. Item-wise analysis of scores and a principal components exploratory factor analysis with varimax rotation were performed on all survey items for all classes.

The Kruskal–Wallis test was used to compare the outcome variables in the four groups, to test the null hypothesis that all populations have identical distribution functions against the alternative hypothesis that at least two of the samples differ only with respect to location (median), if at all. Median and inter-quartile scores of the domains are reported and compared between batches. The median total scores of different subgroups of respondents were compared in appropriate non-parametric tests. A p value of <0.05 was considered significant.

The results of the investigation of gender differences in perception of acquisition of knowledge and skills are expressed as proportions for each item.

Results

The overall response rate was 98.3% (456/464). In a factor analysis of responses to all items on the questionnaire, the knowledge domain, with eight items, had a maximum score of 40; the generic skills domain, with five items, had a maximum score of 25; and the attitudes domain, with three items, had a maximum score of 15.

Three factors in the three domains explained 57.5% of the variance in the data (Figure 1). The first factor, which comprised items 1–6, 9 and 15 on the questionnaire (Appendix A), explained 22.7% of the variance; the second factor, comprising items 7, 8 and 10–12, explained 9.1% of the variance; and the third factor, consisting of items 12–14, explained 15.7% of the variance (Table 1). Item 12 was included in both the second and third factor but was more

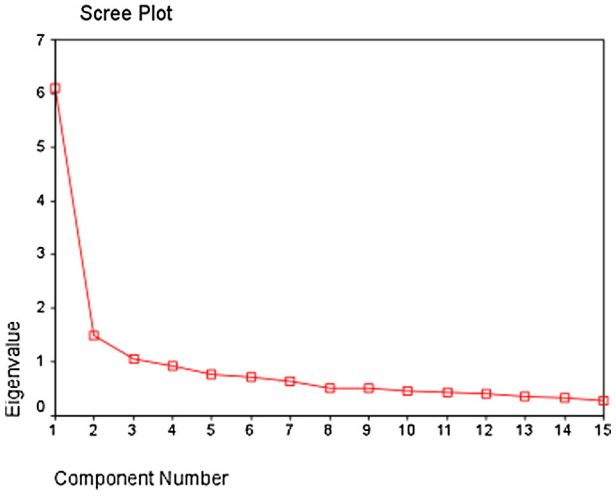

Figure 1: Factors in the three domains that explained variance in the data.

Table 1: Variance explained by the domains of knowledge, skills and attitudes.

Item no. on questionnaire	Subscale		
	Knowledge	Skills	Attitudes
2	0.733		
1	0.721		
4	0.649		
3	0.626		
6	0.623		
5	0.600		
9	0.559		
15	0.435		
7		0.777	
10		0.763	
11		0.718	
8		0.642	
13			0.800
14			0.782
12		0.402	0.690

heavily loaded in the third than in the second factor. All the items loaded only once under the first factor.

A Kruskal–Wallis test showed a statistically significant difference in the median scores of the four batches of students in the first and second domains, corresponding to acquisition of knowledge and generic skills, respectively ($p = 0.005$ and 0.001, respectively). The scores for the third domain were 12/15 for three batches of students and 11/15 for one batch ($p = 0.086$) (Table 2).

The correlation between acquisition of knowledge and generic skills was 0.609–0.718, that between generic skills and attitude was 0.638–0.72 and that between acquisition of knowledge and attitude was 0.451–0.563. There was a significant positive correlation between the scores of the three domains for all batches of students.

The student responses to each of the 15 questionnaire items are shown in Figure 2, in which the outermost circle represents the cumulative effect of the number of students who perceived the advantages of problem-based learning (with response "agree"), which is the largest group. The two innermost circles represent students who did not perceive that problem-based learning was advantageous (with responses "disagree" and "strongly disagree").

There was no statistically significant difference in students' perceptions of problem-based learning by gender.

Discussion

Problem-based learning was perceived by students in all four batches to improve their knowledge, generic skills and attitude, with a positive correlation among the three domains.

Schmidt et al.[4] compared graduates of problem-based and conventional curricula and found that students given problem-based learning rated themselves as having better interpersonal skills, better competence in problem-solving, self-directed learning and information-gathering, and somewhat better skills in areas such as the ability to work and plan efficiently.

In the context of medical education, problem-based learning allows students to develop generic skills and attitudes desirable for their future practice.[5] The final vital step in problem-based learning is to generalise the learning to other situations in which such knowledge, skills and attitude would be applicable.[6]

Boud and Feletti[7] concluded that students taught by a problem-based approach learnt knowledge acquisition, flexibility and deeply rooted theoretical concepts that better equipped them for life-long learning. According to Barrows and Tamblyn,[1] the three objectives of problem-based learning are acquisition of essential knowledge, use of that knowledge in clinical contexts and self-directed learning. These objectives are reflected in the perception of the students in this investigation with regard to the first domain (Figure 1). Students in problem-based learning curricula appear to have better knowledge retention. The approach also generates a more stimulating, challenging educational environment; and the beneficial effects of the generic attributes acquired in this way should not be underestimated.[5] The responses in this study to the development of generic skills were perceived to be positive, as shown in Figure 2. Regarding the development of positive attitudes, item 12, "I have learned to respect other's views within the group", had a maximum rating (82%), representing the perception of the whole group.

Item 1, "Problem-based learning helped me understand the topic better", received the lowest rating (54%), perhaps because the institution implements a hybrid curriculum, and the students also have lectures. They found lectures an easy way of gaining knowledge, whereas exploring their learning objectives and studying through problem-based learning is more time-consuming, especially in subjects such as anatomy.[8] The authors of a study of a Turkish medical curriculum[9] suggested that even if students have a positive reaction to problem-based learning, they dissented on its application. Another reason for the overall low rating for item 1 might be that students in the second year favoured the item, while first-year students had a neutral attitude.

Problem-based learning approaches that encourage small-group activities help to promote outcomes such as teamwork and communication skills.[6] Items 7, 8, 10–13

Table 2: Median scores (first quartile, third quartile) of the four batches of students.

Domain	Median scores (first quartile, third quartile)				
	Second-year seniors	Second-year juniors	First-year seniors	First-year juniors	p
Knowledge	31 (28, 32)	31 (28, 32)	29 (26, 31)	30 (27, 32)	0.005
Generic skills	19 (18, 20)	20 (17, 21)	18 (16, 20)	20 (18, 21)	0.001
Favourable attitude	12 (11, 12)	12 (11, 12)	11 (10, 12)	12 (11, 13)	0.086

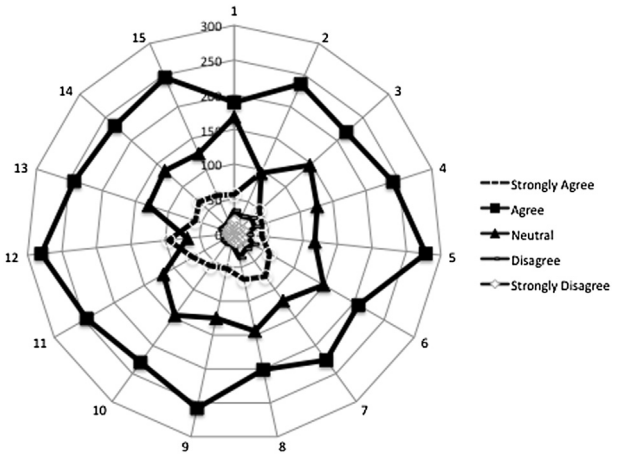

Figure 2: Student responses to each of the 15 questionnaire items.

and 15 addressed this issue, and students gave positive responses. Tan et al.[10] found that students in years 3–5 in their medical school perceived positive benefits of problem-based learning, such as collaboration with colleagues, working in small groups and accountability to other group members. When students in the University of Ottawa School of Nursing generic programme were asked to describe what they derived from problem-based learning, students identified group work and problem-solving most often.[11]

In our study, the median scores of second-year students on all three subscales were more positive than those of first-year students (Table 2). The fact that second-year students encounter problem-based learning twice, in each year of study, might explain their more positive perception. Musal et al.[12] studied the perceptions of first- and third-year medical students on self-study and concluded that the longer experience of third-year students increased their discussion skills.

The weaknesses of the study include the fact that the perception of students was investigated as an immediate, short-term effect, and one of the batches had just 6 months of problem-based learning experience. To gain a better picture, the perception of acquisition of knowledge could be compared with test scores, which would add authenticity to the research. A follow-up study could be useful for determining how problem-based learning helped the students later, in their clinical practice, and a longitudinal study is planned.

Conclusion

This study demonstrates the value and advantages of problem-based learning as perceived by students in a hybrid medical curriculum. Student responses to the questionnaire showed that this learning approach was perceived as helpful for acquiring generic skills and a favourable attitude and behaviour. As problem-based learning is done in small groups, students who learn in this context tend to be oriented towards collaborative learning. Schmidt et al.[13] stated that "problem based curricula do appear to provide a friendlier and more inviting educational climate". Our study implies that we are moving in the right direction. A positive perception by students is one of the first steps to a more favourable attitude to their course as a whole.

The investigators strongly recommend that, in constructing cases for problem-based learning, attention should be paid not only to the psychomotor domain but also to the skills and attitudes that students need to become good doctors.

Conflict of interest

The authors have no conflict of interest to declare.

Appendix A. Questionnaire.

Rate each item on a scale of 1–5 by marking the box in the appropriate column

Item		Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
1	Problem-based learning helped me better understand the topics covered.					
2	Problem-based learning has made me a self-directed learner.					
3	I can develop various hypotheses for a problem encountered.					
4	I can integrate my prior knowledge in the context of the current problem.					
5	I can evaluate the information that I have collected related to a problem.					
6	This form of learning encourages the development of my decision-making skills.					

(*continued*)

Rate each item on a scale of 1–5 by marking the box in the appropriate column						
Item		Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
7	I have learnt to voice my ideas effectively to the group.					
8	Problem-based learning gives me the opportunity to improve my leadership skills.					
9	Problem-based learning improves my information processing skills.					
10	I am able to communicate effectively to the group.					
11	Problem-based learning helps me to participate without always having to lead.					
12	I have learnt to respect others' views within the group.					
13	I am able to identify my ethical and moral obligations to other group members.					
14	I have become aware of my limitations while functioning in a problem-based learning group.					
15	I have learnt to critically analyse information brought by other group members for discussion.					

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