

Student Response to Team-Based Learning and Mixed Gender Teams in an Undergraduate Medical Informatics Course

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إستجابة الطلاب على التعلم القائم على الفريق وفرق اختلاط الجنسين في مساق المعلوماتية الطبية في الدراسات الجامعية

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المخلص: الهدف: يتزايد استخدام التعلم القائم على الفريق في المساقات الطبية والمرتبطة بالطب. الهدف من هذه الدراسة تقييم استجابات الطلاب للتعلم القائم على الفريق لمساق المعلوماتية الطبية في جامعة السلطان قابوس في عُمان. الطريقة: بعد إنجاز 11 جلسة مبنية على التعلم القائم على الفريق خلال فصل دراسي يتكون من 14 أسبوعاً من المساق الثاني للمعلوماتية الطبية في جامعة السلطان قابوس، قمنا بإجراء تقييم للطلبة من خلال شبكة المعلومات العالمية في الأسبوع 13 من المساق. النتائج: من بين 108 طالباً مُدرجاً في المساق، أجاب 96 (88.9%) منهم على الاستبيان، وظهر أن الأغلبية صوتت لصالح استخدام التعلم القائم على الفريق، وحصلت على فائدة كبيرة من جلسات ذلك التعلم. غير أن التقاليد الاجتماعية على ما يبدو قد انعكست سلباً على تجربة الإناث في جلسات التعلم تلك. الخلاصة: أقر الطلاب بفوائد التعلم القائم على الفريق في مساق المعلوماتية الطبية. ومع ذلك وفي مثل هذه البيئة، ينبغي على المشرفين أن يضعوا في الحسبان على الدوام التقاليد الاجتماعية.

مفتاح الكلمات: المعلوماتية الطبية، التعلم القائم على فريق، مواقف الطالب، عُمان.

ABSTRACT: Objectives: Team-based learning (TBL) is increasingly being used in medical and medically-related courses. The aim of this study was to evaluate student responses to a TBL-based course in medical informatics at the Sultan Qaboos University, Oman. **Methods:** A total of 11 TBL sessions were run during a 14-week semester of the Medical Informatics II course at SQU. An online student evaluation was performed in week 13 of the course. **Results:** Of the 108 students on the course, 96 (88.9%) of the students responded to the survey. For the most part, the students regarded TBL favourably, and derived great benefit from the TBL sessions. Cultural norms, however, appear to have impacted negatively on the females' experience of the TBL sessions. **Conclusion:** TBL's benefits in the medical informatics course were recognised by the students. In such an environment, however, facilitators will have to bear in mind and continually address cultural issues.

Keywords: Medical informatics; Team-based Learning; Medical students; Attitude; Oman.

ADVANCES IN KNOWLEDGE

- Team-based learning (TBL) can be applied successfully in undergraduate medical informatics courses.
- The impact of cultural practices that moderate interaction between demographic groups can mostly be reduced, but course facilitators need to be keenly aware of cultural issues.

APPLICATIONS TO PATIENT CARE

- TBL in the undergraduate years has shown itself to be valuable in the acquisition of content necessary for effective patient care during and after the clinical years.
- The social skill of working effectively in teams, crucial to good patient care, can begin to be inculcated in students at a very early stage of their careers, even in a social environment that may mediate against heterogeneous teamwork.

TEAM-BASED LEARNING (TBL) IS increasingly being used in university education, and in the teaching of medical and medically-related courses, but this is not the place to give a detailed description of TBL, as other excellent descriptions exist.^{1–9} Nevertheless, it is useful to note that a TBL session emphasises active learning and follows a process during which students receive stimulus material (e.g. readings), perform a short multiple choice question (MCQ) test taken individually, followed by the same MCQ test taken in teams of 5–8 students. The two tests are frequently referred to as the individual readiness assessment test (IRAT), and the group readiness assessment test (GRAT) respectively.^{2,4,7,10} The scores from the tests usually contribute significantly towards the final course assessment. Feedback on the GRAT is given immediately in class, and the TBL session continues with a more in-depth question in which the information learned is applied. This is followed by further feedback and clarifications from the facilitator.

Apart from the pedagogical value of TBL, and its demonstrated positive impact on examinations, using TBL in medical professional training has a further advantage: medical professionals need to be able to work in diverse teams and TBL offers a fine opportunity for medical students to come to grips with the complexities of teamwork at an early stage in their training.^{2,11–15} These skills should be included in the students' training, and can be learned (along with attitudes and values) through practice.^{2,16–22}

In 2010, the College of Medicine and Health Sciences at Sultan Qaboos University (SQU) in Oman hosted TBL workshops for staff who were interested in using TBL in their courses. In 2011, the author implemented TBL in the Medical Informatics II course. This course has 4 contact hours per week, builds on the more basic Medical Informatics I course, runs through a 14-week semester, covers a range of theoretical and practical aspects of medical informatics, and is designed to equip the students with the foundational attitudes, knowledge, and skills in information systems required by doctors.

In the first week of the Medical Informatics II course, students were given an orientation to TBL, and were then able to run through the TBL process twice. As part of the course orientation, the need for teamwork in medical practice was described,

with reference to common practices in Oman and internationally, and the link between this teamwork and TBL was made. During the course, students were frequently reminded of this by reference back to the discussions in the orientation week; the overarching philosophy was that TBL was part of their training as members of a health care team.

As part of this orientation, a small but significant change was made to the nomenclature. In much TBL writing, the words “group” and “team” appear to be used interchangeably.⁹ Reference has already been made to the fact that the assessment taken by the team is usually referred to as a *group* readiness assessment test (GRAT).^{2,4,7,10} The confusion of “group” with “team” is antithetical to the concept of teamwork in general, and it was felt would undermine the *team* aspect of TBL. As a result, the instructor never used the word “group,” and the team assessment was always referred to as a *team* readiness assessment test (TRAT) to emphasise that it was an assessment taken by a *team*. The term TRAT is used in the rest of this paper.

Because the first two TBL sessions held in the first week were practice sessions, they did not contribute to the course grade (this work was examined in the final examination). During the orientation, the instructor divided the students into 14 teams of 7–8 students each. Students were randomly chosen except in the case of gender: because of the high female to male student ratio on the course, there was a need to ensure that each team had at least two males. The teams of students remained fixed for the duration of the course. The objectives and readings for each TBL session were made available in the Learning Management System (LMS) at the start of the semester.⁵ In preparation for each TBL session, students had to read approximately five pages of text.

During the rest of the semester, a 2-hour TBL session was run every week for 11 weeks, while the other 2-hour weekly contact time of the course consisted of student presentations on advanced topics. During each session, the IRATs and TRATs consisted of 5 MCQs covering the basics of the topic. Students had 8 minutes to complete the IRAT, and 15 minutes to complete the TRAT. Because the attendance policy at SQU allows students to be absent from some classes, only the highest nine IRAT and TRAT scores would contribute to the students' scores.

Table 1: Flesch Reading Ease and Flesch-Kincaid Grade Level of the consent and survey forms

System Item	Scoring	Flesch Reading Ease	Flesch-Kincaid Grade Level
Consent form		50.6	9.9
Survey		64.9	6.2

The IRAT and TRAT scores each counted for 20% of the total score for the course. This proportion is in line with practices elsewhere, and is considered a substantial contribution.^{1,3,4,10} Because the course was a medical informatics course, classes were held in computer laboratories. As a result, the IRATs were taken online. The students then broke into their teams in the computer laboratory and continued with the TRAT. After the TRAT, application questions were given, and students had approximately 45 minutes to solve the problems. This was followed by feedback and wrap-up.

When running TBL sessions at SQU, however, one needs to be sensitive to a particular aspect of Omani culture that may conflict with a central tenet of TBL. TBL expressly relies on the diversity of the teams in respect to culture, background, and gender.⁹ In Oman, classes in public schools after 5th grade are usually single-gender (although not all students at SQU are from public schools), and interaction between genders outside of one's family is generally discouraged. In the College of Medicine & Health Sciences, while classes are of mixed gender, the students separate themselves by gender in the classroom. The result is that the majority of the college's undergraduate students are not used to working in mixed gender teams. It was expected that this would have an impact on the running of the TBL sessions. Given the professional needs within this complex setting, this study set out to gauge the students' reactions to TBL in their course.

Methods

The study was conducted among the 108 medical students at SQU who were taking the Medical Informatics II course in the spring semester of 2011. An in-course evaluation of the TBL process, conducted three weeks into the course, indicated that there had been a general acceptance of the new teaching model amongst students, although there was also some reluctance and uncertainty.

The literature indicates that this is common in the early stages of TBL introduction.⁷ The issues and problems raised by the students regarding the process were addressed, and the process continued.

While the results of the preliminary evaluation were useful because the evaluation had been conducted early in the semester, there was the risk that results may have been influenced by the novelty of the teaching method. There was a need to determine students' attitudes towards TBL after 11 sessions of TBL across the semester.

For this study, a survey form and consent form were created. The core of the survey form was based on the 12-item survey form by Wiener, Plass and Marz.⁸ Students responded to statements with a Lickert scale running from 1 (strongly disagree) to 6 (strongly agree). Small language changes were made to some of Wiener *et al.*'s questions to account for local interpretations, and additional questions were added to gather further information about students' attitudes towards TBL. Because of the cultural issues discussed above, a crucial question regarding the comfort of students working in mixed-gender teams was also added. Finally, an open text question allowed students to add any further comments.

The in-course TBL evaluation used this revised form and also served as a pilot for students' feedback on the questionnaire. As a result of students' feedback, some minor language alterations were made to the questions. A consent form was designed, based on a standard consent form used in previous research by the author, and approved by SQU. The consent form indicated that the survey was anonymous, and students were under no obligation to participate.

The language of instruction at SQU is English, but many of the students do not have English as their mother tongue. As a result, the language of the consent form and the survey form needed to be easily accessible. Common (albeit not absolutely perfect) scales of measuring English language levels are the Flesch Reading Ease and the Flesch-Kincaid Grade Level.^{2,31} Using these scales, the level of English of the consent and survey forms was determined as shown in Table 1. The figures indicate that the forms would be understood by native English speakers in middle school, so the students in this study would be able to understand the forms. Ethical approval for the study was granted by the SQU College of Medicine & Health Sciences Medical Research &

Table 2: Student responses to questions in the TBL survey (N = 96)

	Options			Mean score (Sc) and standard deviation (SD)						
	Numerical scale and percentage responses N = 96			Total Sample N = 96		Female n = 52		Male n = 38		P
Questions put to students	1–2	3–4	5–6	Sc.	SD	Sc.	SD	Sc.	SD	
I do the readings properly before the TBL sessions.	3	29	68	4.7	1.1	5.1	0.8	4.4	1.4	0.02
The IRATs are a good test of my knowledge.	6	34	59	4.6	1.2	4.8	1.1	4.6	1.3	0.86
The TRATs help to clarify areas that I'm unsure of.	5	19	76	5.0	1.2	5.3	1.0	4.8	1.2	0.04
The discussion after the TRAT clarifies areas that I'm unsure of.	3	31	66	4.8	1.1	4.9	1.0	4.9	1.3	0.81
The appl. questions are useful for applying the basic knowledge.	4	49	47	4.3	1.0	4.4	0.9	4.3	1.2	0.53
I believe the TBL sessions are more valuable than normal lectures.	5	38	57	4.6	1.2	4.6	1.2	4.7	1.3	0.56
I enjoy the TBL sessions.	7	42	51	4.5	1.3	4.3	1.3	5.1	1.1	0.00
TBL helps to assess present knowledge.	1	43	56	4.6	1.0	4.7	1.0	4.8	1.0	0.65
TBL helps to get me to a higher level of knowledge.	4	42	54	4.6	1.0	4.7	1.0	4.5	1.1	0.44
TBL reduces the amount of time needed for self-study.	10	44	46	4.2	1.2	4.4	1.2	3.9	1.3	0.09
TBL challenges me to give my best.	3	51	46	4.4	1.0	4.6	1.0	4.4	1.1	0.25
TBL has a positive impact on my learning attitudes.	1	41	58	4.6	1.0	4.5	0.9	4.7	1.0	0.47
TBL is an effective, motivating learning strategy.	4	32	65	4.7	1.1	4.7	1.2	4.9	1.0	0.39
The lecturer facilitated the learning process well.	5	26	69	4.8	1.2	5.0	0.9	5.0	1.4	0.30
The TBL course is well organized.	3	21	76	5.0	1.1	5.0	1.0	5.2	1.2	0.13
I would recommend TBL to other students.	3	29	68	4.9	1.1	4.7	1.1	5.2	1.1	0.02
TBL should be offered more frequently in the curriculum.	5	42	53	4.5	1.3	4.3	1.3	5.0	1.2	0.01
Overall, I am very satisfied with this TBL approach.	14	38	59	4.6	1.1	4.5	1.1	4.9	1.1	0.13
I frequently study with colleagues.	25	34	41	3.8	1.6	3.8	1.5	4.0	1.7	0.43
I am happy working in a TBL team with males and females together.	21	25	54	4.3	1.7	3.7	1.8	5.2	1.3	0.00

Legend: TBL = team-based learning; IRAT = individual readiness assurance test; TRAT = team readiness assurance test

Ethics Committee (MREC #417).

The survey was conducted electronically near the end of the semester (May 2011), in week 13, by which time 11 TBL sessions had been run. The survey remained open for a week. All data were collected and stored anonymously and electronically, and were secured by means of passwords and 256-bit encryption. The data were placed into a Microsoft Excel 2010 spread sheet (Microsoft, Redmond, Washington, USA), and descriptive statistical analyses were performed. Wiener *et al.* had used the Mann-Whitney U-test to determine the differences

in responses based on gender, so, for consistency in the comparison of the two studies, the Mann-Whitney U-test was also chosen for analysis of the data in this study (QI Macros SPC Software for Excel, KnowWare International, Denver, Colorado, 2012), and statistical difference was taken at $P < 0.05$.

Results

Attendance at the TBL sessions was 96.97%, with only three students missing the maximum allowable number of two TBL sessions. A total of 96 students

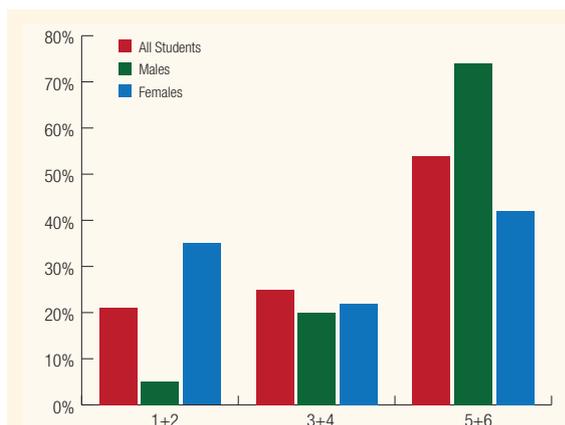


Figure 1: Graph showing percentages of responses to the question “I am happy working in a TBL team with males and females together.” 1 = strongly disagree; 6 = strongly agree.

completed the survey form, giving a response rate of 88.9%. Of the 96 students, 90 indicated their gender, of which 38 (42.2%) were male. There was no statistical difference between the female/male ratio of the respondents and the total class population. The students’ responses to the questions are given in Table 2. For purposes of reporting, following the process given by Wiener *et al.*⁸, the responses to the Lickert scale were reduced to three groups (1–2; 3–4; 5–6).

On the organisation and facilitation of the TBL sessions, the students were generally satisfied, and there was consistency of satisfaction across both genders. In addition, there is general acceptance of the effectiveness of the TBL process (including the discussion after the TRATs), and the belief that TBL is more valuable than normal lectures. Overall, more than half the class enjoyed the TBL sessions, but 42% were neutral. The application questions, however, were not seen to be as valuable as the IRAT and TRAT.

Obvious, however, was the significant differences between a) females and males in the enjoyment of the TBL session (4.3 vs. 5.1); b) the likelihood of recommending the method to other students (4.7 vs. 5.2), and c) the interest in the College offering TBL more frequently (4.3 versus 5.0). The greatest difference between female and male scores, and possibly the root for the other differences, is that females were far less happy than males to work in mixed-gender teams (3.7 versus 5.2).

Superficially, one might be tempted to believe that this lower figure amongst females is simply a

gravitation towards the central options (3 and 4) on the Lickert scale, and that the females did not have particularly strong feelings either way. When inspecting these figures in more detail, however, we find that this is not the case. Figure 1 indicates that, while there are fewer females agreeing with the statement, the central gravitation had not occurred. The reason for the low mean score was that a large number of females appeared directly *opposed* to the mixed-gender groups. A total of 19.2% of the females selected “strongly disagree” and 15.4% selected “disagree” in response to questions about working in mixed-gender teams, giving a combined score of 34.7%, as opposed to only 5.3% for the males [Figure 1]. In the open text response question, two female students commented negatively on the mixed-gender teams. One of them wrote: “*We are not happy to work as males and females together, so we prefer to separate us as groups of males and other groups of females.*”

In addition, during the running of the TBL sessions, almost all the teams formed themselves into sub-groups, split on gender lines. The facilitator had to tread a delicate line of encouraging greater cohesion while ensuring that cultural sensitivities were not offended. This was usually done with reference to the need for cohesion in clinical teams. Students were informed that they were already doctors, but in their early stages of their training, and that the problems to be solved should be viewed as if they were those of actual patients in need of the best possible medical care. It was underlined that this could be provided only by a proper team of medical personnel. By the end of the semester, there was greater cohesion within teams, with most of the teams forming a circle around a computer or two. They were still, however, divided along lines of gender, and some teams remained in a single row, refusing to form a cohesive circle of any type.

An added factor that may have led to the dissatisfaction amongst the females is that the results indicate that the males did less reading preparation than the females, and many females may have felt that they were being forced to carry the load in the TRATs.

This paper focuses on student responses, and so does not report on student performance in any detail. Nevertheless, because an important reason for emphasising teamwork is to improve on individual performance, it is appropriate to report

briefly on aggregated data. For the class, the mean IRAT score was 87.9% (range: 60–100%) and the mean TRAT score was 99.7%, with most teams scoring 100%. Similar scores have been found elsewhere.¹⁰

Discussion

For the most part, there was a positive response to the value of TBL, its ability to increase knowledge, and its benefits in comparison to the value of lectures. This positive attitude has been found by several other researchers.^{3,4,8,24} The increase in scores from IRAT to TRAT certainly demonstrated the value of working in teams. In addition, the students mostly enjoyed the sessions. Specifically, 51% of the students enjoyed the TBL sessions, 42% were neutral, and only 7% did not enjoy the sessions. Although the facilitator would have preferred a greater indication of enjoyment, these figures are encouraging, especially when viewed in the light of other research.¹ (The issue of the male/female dichotomy is discussed below).

There may be many factors that increase student enjoyment of TBL. The results certainly indicate that the students recognise that the course was well-organised, and this would have an impact on their perception of the course. In addition, having the TBL so early in their medical training might have helped because they had not yet come to believe that PowerPoint-driven lectures are the only method of teaching at university, as has been suggested by other researchers.¹

This early offering of TBL, however, may also have a great disadvantage. At this early stage, the students are not convinced of the need to work in teams, especially as so much of their other course work is individually assessed. Trying to convince students that they will need to learn to work in teams for their later student years, as well as during their medical careers, may sound like trying to sell a concept rather than preparing them for that scenario.

In this cultural setting, this would have been a particular problem and was possibly exaggerated by the fact that the course convenor and facilitator was a non-Omani male who may have been perceived to be importing foreign and culturally-insensitive practices into the curriculum.

Readers familiar with TBL may have noticed

that these sessions did not have peer-evaluation. A system of peer-evaluation is recommended as a crucial part of TBL, primarily because it encourages individual accountability, and has been implemented by several researchers.^{4,5,7,9} Some of these researchers, however, have reported that the peer-evaluation system is manipulated by students and also causes great dissatisfaction amongst them.^{4,7} For these reasons, the facilitator decided that having both the IRAT and TRAT each counting 20% of the course grade would be enough incentive for individual accountability. As a result, at this stage, there is no plan to introduce peer-evaluation; however, the course could probably benefit from future course evaluation questions on participation in teams. This would be especially important given the apparent differences between males and females in the reading preparation described above.

There is also the argument that, as TBL contributes as much as 40% of the overall grade, this could inflate the end-of-year grade. A counter argument, however, is that it makes little sense to introduce TBL, and to emphasise the need to work in teams, unless one is prepared to have it contribute significantly to the students' final marks. Allowing the students to skip 2 out of 11 sessions possibly inappropriately boosted their grades, so this allowance may be reduced to only 1 in the future.

The greatest problem encountered was that of the mixed-gender teams. Gender segregation exists at other public higher education institutions in the Arabian Gulf region.^{25–27} Unfortunately, this segregation—and its possible impact on education—is seldom mentioned or discussed when researchers present overviews of the educational environment at institutes of higher education in the Gulf region.^{28–30} This is a shortcoming that has been investigated in other cultural settings.³¹ As a result, this would appear to be an area for more detailed future research.

At this stage, when we compare the results of this study to Wiener *et al.*'s results, we can see there are similar male/female trends in the response to many of the questions.⁸ Simultaneously, however, when one looks at questions dealing with recommending TBL to other students, offering TBL more in the curriculum, and overall satisfaction with TBL, one sees that there is a reversal: females in this study were less satisfied than the males.

Until further research is conducted, it will be prudent for the facilitator of such a course to be vigilant about the gender issue. However, as TBL becomes used more frequently in the students' courses, the problems associated with mixed-gender teams may subside. Although this study covered the impact of 11 TBL sessions, it was conducted in one course in one university only. The results will benefit from repeated studies to determine the overall student response to the use of TBL in medical informatics classes. In addition, because the cultural impact had not been foreseen, there were too few questions regarding students' backgrounds for a detailed understanding of possible reasons behind the students' responses. A repeat study should include questions on students' ages, ethnic background, schooling, and whether their family is from an urban or rural setting.

Conclusion

Team-based learning is being increasingly used in medical and medically-related courses. This paper has described the student response to the use of TBL in a medical informatics course in the College of Medicine & Health Sciences at SQU in Oman. For the most part, the students accepted the use of TBL in the course and perceived the benefits; however, issues pertaining to Omani cultural norms may have impacted negatively on the females' perceptions of TBL. Because working in mixed-gender teams is crucial to the delivery of health care, facilitators working in such sensitive cultures will need to address the issue continually so that that the students' experience of TBL is as positive as possible.

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DISCLAIMER AND CONFLICT OF INTEREST

The author is the sole author of the paper. There are no known conflicts of interest.

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