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Perceptions of team-based learning using the Team-Based Learning Student Assessment Instrument: an exploratory analysis amongst pharmacy and biomedical students in the United Kingdom

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Purpose: This study aimed to evaluate students’ perception of team-based learning (TBL) amongst a cohort exposed to this methodology for the first time at a university in the United Kingdom.

Methods: Between November and December 2018, 26 first-year Master of Pharmacy and 90 second-year Biomedical Science students of the School of Life Sciences, University of Sussex, United Kingdom were invited to participate and requested to complete a questionnaire that contained quantitative and qualitative questions. The quantitative component was based on the Team-Based Learning Student Assessment Instrument (TBL-SAI). It additionally contained questions about key student characteristics.

Results: The response rate was 60% (70 of 116); of the participants, 74% (n=52) were females and 26% (n=18) males. The percentage of agreement in the TBL-SAI suggested a favourable response to TBL. The overall mean score for the TBL-SAI was 115.6 (standard deviation, 5.6; maximum score, 140), which was above the threshold of 102, thus suggesting a preference for TBL. Statistically significant differences were not found according to demographic characteristics. Students who predicted a final grade of ≥70% strongly agreed that TBL helped improve their grades. Some students highlighted issues with working in teams, and only 56% of students agreed that they could learn better in a team setting.

Conclusion: This study shows that students exposed to TBL for the first time favoured several aspects of TBL. However, more focused strategies including team-building activities and expert facilitation skills could potentially tackle resistance to working in teams.

Keywords: Cohort studies; Pharmacies; Self-directed learning as topic; Students; United Kingdom

Introduction

Team-based learning (TBL) was introduced in the United States as an alternative to traditional methods of teaching by Larry Michaelsen, and since then it has become an increasingly popular teaching strategy worldwide [1]. A systematic literature review documented the use of TBL in the health professions in 23 countries, demonstrating that the number of articles published on TBL increased steadily, tripling between 2011 and 2016 [2]. There is some published literature from the United Kingdom (UK) [3-5]; however, literature on this topic from the UK remains scant in comparison to the global landscape, and hence there is a need to define its use and perception in the context of local demographics.

Starting in 2016, at the University of Sussex, we implemented TBL in a blended learning environment, supplementing and part-
ly replacing lectures as the teaching method across 2 different degrees: pharmacy and biomedical science. In the UK, students are generally accustomed to didactic teaching; TBL represents a shift to dialogic learning, which leads to new understanding and knowledge, greater student engagement, and improved thinking skills because meanings are constructed from the inside by learners in a dialogue instead of being imposed from outside. The aim of the study was to evaluate students’ perception of TBL amongst a cohort of students who were exposed to this methodology for the first time at this university with the aim of informing future curriculum development. The hypothesis was to assess whether students favoured TBL over lectures.

Methods

Ethics statement

The study was conducted in accordance with the Helsinki Declaration of 1975 as revised in 2008, and received ethical approval from the Life-Sciences-Psychology Cluster-based Research Ethics Committee of the University of Sussex on 9/11/2018 (ref: ER/PP225/1). Informed consent was obtained from all individual participants included in the study.

All data were handled following the requirements of the Data Protection Act (2018) and/or the General Data Protection Regulation (GDPR) 2016 according to European Union law; therefore, data were anonymised and stripped of any identifiable references to the participants.

Study design

This was a cohort study.

Study population

In this study, 26 first-year pharmacy and 90 second-year biomedical science students were invited to participate.

TBL sessions in the pharmacy programme were embedded into the MPharm curriculum and conducted every 2 weeks in a 2-hour teaching session. Pre-reading consisted of specific lecture content and self-directed learning through books and internet resources. In a 2-hour session, students completed the readiness assurance test (RAT) and application exercises. In contrast to pharmacy class, biomedical science students were exposed to TBL for the first time in the second year in a module covering general anatomy and haematology. The RAT sessions were based around pre-reading in the form of mini-PowerPoint recorded lectures. This was followed by 1–4 hours’ lecture on each theme and subsequently, application exercises integrating the RAT and lecture content. Both courses had 5 TBL sessions in the 12-week teaching term.

Research instrument

The validated Team-Based Learning Student Assessment Instrument (TBL-SAI) developed by Mennenga was used [6]. The questionnaire was adopted to gather also students’ characteristics such as age, gender, ethnicity, residence, status, entry qualification to the university, and prediction of their grade for the module. Permission for using TBL-SAI was obtained from the original author. The TBL-SAI includes 33 questions aimed at investigating 3 dimensions: accountability (8 items), preference for lecture or TBL (16 items) and student satisfaction (9 items) with a 5-point Likert scale. During the final TBL teaching session, and following informed consent, students were invited to fill out an online questionnaire delivered through a web platform called Qualtrics available from: https://www.qualtrics.com.

Sample size calculation

The required sample size (n = 67) was calculated using the t-test to assess the mean difference from the constant (1 sample) with 2 tails, effect size (Cohen d = 0.5), a = 0.05, critical t = ± 1.99, and a power of 98%. The power analysis was conducted using G*Power version 3.1.9.3 (http://www.gpower.hhu.de) [7].

Statistical analysis

Quantitative data were analysed using descriptive statistics. The internal consistency of TBL-SAI was assessed using the Cronbach a. Furthermore, a scoring system was applied to TBL-SAI, according to Nation et al. [4], which defined a score of > 102 as indicative of a preference for TBL. The Kolmogorov-Smirnov test was used to assess the normality of the data distribution. Data were presented as range, mean and standard deviation as suggested by Norman (2010) [8]. The Student t-test was used for analysing demographic characteristics and the mean values of the total TBL-SAI score. Differences in the mean of the total TBL-SAI score (as thresholds) according to demographic characteristics were analysed using the Pearson chi-square (χ²) and/or Fisher exact tests, with odds ratios and 95% confidence intervals.

Correspondence analysis, a multivariate statistical technique, was conducted to identify the relationships between 2 categorical variables, the impact of TBL on grades and grade prediction. Qualitative comments were analysed using thematic analysis, stratified as reflective of positive or negative attributes. Negative comments were further classified into themes such as issues with working in teams and the conduct of TBL activities. Qualitative comments were linked to the total score obtained with the TBL-SAI using the mean value as a threshold. The analyses were conducted using IBM SPSS ver. 24.0 (IBM Corp., Armonk, NY, USA) and Microsoft Excel ver. 2016 (Microsoft Corp., Redmond, WA).
WA, USA). A P-value < 0.05 was considered to indicate statistical significance.

**Results**

**Demographic characteristics**

Seventy students participated in the study. The response rate was 60.3% (70 of 116); this included 52 (74.3%) biomedical science students and 18 (25.7%) pharmacy students, giving response rates of 57.7% (52 of 90) and 69.2% (18 of 26), respectively. There was a predominance of female students, and 90% of the students in our samples were in the 16- to 24-year range (Table 1).

**Internal consistency of the TBL-SAI**

The Cronbach α for the TBL-SAI (33 items) was 0.651; this low value was accepted due to the exploratory nature of the analysis, which is in line with the study conducted by Jeno et al. [9] in 2017. The Cronbach α values for accountability, preference for lecture or TBL, and student satisfaction were 0.501, 0.412, and 0.626, respectively.

**Students’ responses to the TBL-SAI instrument**

Fig. 1 presents students’ responses to selected statements (14 of 33) across 3 domains. The responses to most questions suggested that students favourably accepted several features of TBL. A high percentage of students agreed and strongly agreed that they felt the need to prepare for the class (85.7%) and contribute to their team’s learning (84.2%). TBL appeared to be more engaging, as more students agreed that they were easily distracted in lectures as compared to TBL (65.7% versus 22.9%). It was also a useful revision tool, with more students agreeing that they found it easier to remember material following TBL than after lectures (74.2% versus 28.6%); in particular, strong agreement was noted with the statement “I remember material easier following application exercises” (92.9%). Overall, a high percentage of students agreed that they had a good experience with TBL (77.1%) and that it was fun (64.2%).

While most elements of TBL were positively received by students, we noted some resistance, which could be gathered from a lower percentage agreeing that they felt accountable for the team’s learning (41.4%) and had the perception of learning better in a team (55.7%). The responses for each domain of the TBL-SAI are presented in Appendix 1.

All 3 dimensions included in the TBL-SIA instrument achieved a score well above the threshold favouring TBL (Table 2).

**Demographic characteristics and TBL-SAI scores**

Table 3 shows that statistically significant differences were not identified when computing demographic characteristics and the mean total TBL-SAI total score. A further analysis was conducted of demographic characteristics according to the total score threshold (102) and total mean score threshold (115.6), and this analysis likewise did not show statistically significant differences (Table 4).

**Correspondence analysis**

Most students predicted a grade in the range of 60%–69% (n = 25, 35.7%) or 70%–79% (n = 33, 47.1%). Due to the small numbers in the other grade categories, conclusions could not be drawn for them. The analysis suggested a link between students who predicted a grade of 70% or above and those who agreed with the statement "I think team-based learning activities help improve my grade" (Fig. 2).

**Students’ comments**

Amongst 70 respondents, 24 provided qualitative comments, which were stratified and grouped according to the 3 themes presented in Table 5. Out of 24 students, 18 students highlighted at least 1 positive attribute of TBL, including comments such as:

“TBL should be incorporated into all modules.” (Biomedical science student no. 15)

“I enjoyed working in a team, especially as it is a nice break from the monotony of most non-interactive lectures.” (Biomedical science student no. 48)
“I prefer this over lectures.” (Biomedical science student no. 14)
“TBL is a great way to make a class more interesting and therefore it gives me greater stamina to learn.” (Pharmacy student no. 65)

Six students highlighted issues with working in teams, and 5 of these comments were from students with TBL-SAI scores of less than 115.6. However, all these students still had a total score > 102, which is the defined threshold for a positive perception of TBL in the TBL-SAI instrument. Comments included:

“Sometimes working with people you’re not friends with makes team-based learning less effective and a little isolating.” (Biomedical science student no. 11)
“I would have preferred smaller groups too, as it is sometimes intimidating working in a big group of people I don’t know in such academic setting.” (Biomedical science student no. 16).

All comments highlighting this issue around teamwork were from biomedical science students. In addition, 6 students across biomedical science and pharmacy highlighted issues related to the actual conduct of TBL, with key issues being the lack of recorded material for the individual RAT and team RAT activities, the time allocated for discussion, and the length and timing of application exercises. The raw data are available in Supplement 1.

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**Fig. 1.** Students’ responses to selected statements across 3 domains: accountability, preference, and student satisfaction. Numbers within bars represent the frequency of responses for each option of the 5-point Likert scale. TBL, team-based learning.

**Table 2.** Scores according to the dimensions of the TBL-SAI questionnaire

| Statements                                                                 | Accountability | Preference of teaching style | Students’ satisfaction | Total score |
|----------------------------------------------------------------------------|----------------|-----------------------------|------------------------|-------------|
| Mean ± SD                                                                 | 28.6 ± 3.1     | 55.2 ± 4.9                  | 31.8 ± 4.1             | 115.6 ± 5.6 |
| Reference range                                                           | 20–35          | 43–69                       | 22–39                  | 94–140      |

The reference range represents the threshold for each dimension and the total score of TBL-SAI. The measures of the lowest and highest TBL-SAI scores are represented by the range, central tendency by the mean, and dispersion by the SD.

TBL-SAI, Team-Based Learning Student Assessment Instrument; TBL, team-based learning; SD, standard deviation.
Table 3. Demographic characteristics according to the means of the total TBL-SAI score

| Demographic characteristic | Total TBL-SAI score | 95% Confidence interval | P-valuea) |
|----------------------------|--------------------|-------------------------|-----------|
|                            | Mean               | Mean difference         |           |
| Gender                     |                    |                        |           |
| Male                       | 114.05             | -2.11                   | -6.800 to 2.565 | 0.370 |
| Female                     | 116.17             |                        |           |
| Age range (yr)             |                    |                        |           |
| 16–24                      | 115.09             | -5.33                   | -12.074 to 1.407 | 0.119 |
| > 24                       | 120.42             |                        |           |
| Ethnicity                  |                    |                        |           |
| White                      | 114.38             | -3.34                   | -7.528 to 0.839 | 0.115 |
| Others                     | 117.73             |                        |           |
| Entry qualification        |                    |                        |           |
| A level/LIB                | 116.39             | 1.83                    | -2.317 to 5.994 | 0.318 |
| Other qualifications       | 114.55             |                        |           |
| Degree                     |                    |                        |           |
| Biomedical science         | 116.03             | 1.59                    | -3.101 to 6.289 | 0.500 |
| Pharmacy                   | 114.44             |                        |           |

TBL-SAI, Team-Based Learning Student Assessment Instrument.

aStudent t-test; statistical significance P<0.05. Residence was not included in the analysis due to the very low numbers of non-United Kingdom/non-European Union students (n=3).

Table 4. Demographic characteristics and total TBL-SAI score thresholds

| Demographic characteristic | TBLb) ≤ 102 | > 102 | OR (95% CI) | P-valuec) | TBL meand) ≤ 115.6 | > 115.6 | OR (95% CI) | P-value |
|----------------------------|-------------|-------|-------------|-----------|---------------------|---------|-------------|---------|
| Gender                     |             |       |             |           |                     |         |             |         |
| Male                       | 2 (11.1)    | 16 (88.9) | 2.042 (0.313–13.328) | 0.597     | 10 (55.6) | 8 (44.4) | 0.991 (0.337–2.916) | 0.987 |
| Female                     | 3 (5.8)     | 49 (94.2) |                     |           | 29 (55.8) | 23 (44.2) |                     |       |
| Age range (yr)             |             |       |             |           |                     |         |             |         |
| 16–24                      | 4 (6.3)     | 59 (93.7) | 0.4 (0.039–4.251) | 0.419     | 36 (57.1) | 27 (42.9) | 1.778 (0.367–8.613) | 0.692 |
| > 24                       | 1 (14.3)    | 69 (85.7) |                     |           | 3 (342.9) | 4 (67.1)  |                     |       |
| Ethnicity                  |             |       |             |           |                     |         |             |         |
| White                      | 3 (6.8)     | 41 (93.2) | 0.878 (0.137–5.633) | 1         | 27 (61.4) | 17 (38.6) | 1.853 (0.695–4.943) | 0.216 |
| Others                     | 2 (7.7)     | 24 (92.3) |                     |           | 12 (46.2) | 14 (53.8) |                     |       |
| Entry qualification        |             |       |             |           |                     |         |             |         |
| A level/LIB                | 2 (4.9)     | 39 (95.1) | 0.444 (0.069–2.846) | 0.642     | 23 (56.1) | 18 (43.9) | 1.038 (0.399–2.704) | 0.939 |
| Other qualifications       | 3 (10.3)    | 26 (89.7) |                     |           | 16 (55.2) | 13 (44.8) |                     |       |
| Degree                     |             |       |             |           |                     |         |             |         |
| Biomedical science         | 3 (5.8)     | 49 (94.2) | 0.49 (0.075–3.197) | 0.597     | 27 (51.9) | 25 (48.1) | 0.54 (0.176–1.656) | 0.278 |
| Pharmacy                   | 2 (11.1)    | 16 (88.9) |                     |           | 12 (66.7) | 6 (33.3)  |                     |       |

Values are presented as number (%) or OR (95% CI), unless otherwise stated.

TBL-SAI, Team-Based Learning Student Assessment Instrument; TBL, team-based learning; OR, odds ratio; CI, confidence interval; FET, Fisher exact test.

aTBL cut-off score threshold=102. bMean of the total score as threshold=115.6. cBy Pearson chi-square or FET; The choice between χ² and FET was made according to the data requirements.
dAdvanced level, or A level, is a main school-leaving qualification in England, Wales, Northern Ireland, the Channel Islands, and the Isle of Man. eInternational Baccalaureate is an international educational qualification.
Discussion

The main aim of our study was to explore students’ perceptions of TBL when they were exposed to this methodology for the first time at university. We surveyed students across courses in 2 different subject areas: pharmacy and biomedical science. Although there were inherent differences in the blended approach in these courses, including the year of study when TBL was first introduced (first year in pharmacy and second year in biomedical science), we believe this did not have an impact on the overall perceptions, which appeared to be favourable for TBL. The overall TBL-SAI score of 116 was higher than the threshold (≥ 102) that suggests a preference for TBL, and similar scores were noted in other similar healthcare-related subject areas [4,10,11]. Statistical significantly different scores were not found in the total TBL-SAI mean scores and thresholds (102 versus 115.6) according to demographic characteristics and disciplines.

Several key pedagogical ideologies underpin TBL. These include encouraging self-reading, holding students accountable for their learning, and the use of effective authentic assignments that trigger discussions amongst teams [12]. The percentage of agreement with several statements suggests that our courses were successful in embedding these attributes into the learning process. Over two-thirds of the students agreed that they needed to contribute to their team’s learning, and the majority felt that they had to prepare for class if they would like to do well. Students found TBL more engaging and less distracting than lectures.

In our study, correspondence analysis showed a link between perceived academic potential (shown by anticipated grades of 70% and above) and agreement with the statement “I think team-based learning activities help improve my grade.” Improved perceptions amongst high academic achievers have been documented by other studies [13,14]. Vasan et al. [13] noted a similar pattern and suggested that high achievers may have more effective existing study patterns, such as self-study and group study. It is also possible that team dynamics and interactions may alter perceptions, as academically more able students have the chance to dominate academic discussions and thus favourably perceive TBL. At this stage, it would be premature to draw conclusions. The use of qualitative methods such as focus groups or interviews could reveal reasons behind grade perceptions and inform future sessions.

Although the responses to the TBL-SAI suggested a preference for TBL, we noted a few challenges with TBL. Several students’ comments indicated team-related issues, which appeared to drive

Table 5. Themes according to the mean of the total TBL-SAI score as the threshold

| Themes                                | Score > 115.6 (n = 17) | Score ≤ 115.6 (n = 7) |
|---------------------------------------|-------------------------|-----------------------|
| Positive features of TBL highlighted  | 12                      | 6                     |
| Team issues highlighted               | 1                       | 5                     |
| Conduct issues highlighted            | 4                       | 2                     |

TBL-SAI, Team-Based Learning Student Assessment Instrument; TBL, team-based learning.
a lower score in the TBL-SAI instrument. The specific comments emanating from the biomedical science students could be attributed to large class sizes, a sudden resistance in the second year when students were being forced to shake off some habits that were formed in the first year, and the sessions being facilitated by a single instructor. We also hypothesised that students’ characteristics such as age or gender could influence this perception, however, we did not find any statistically significant differences according to age or gender. In addition, only 56% agreed or strongly agreed that they learned better in a team setting, and this was similar in both courses. Sharma et al. [10] in 2017 also noted resistance as gauged by responses to the relevant TBL-SAI questions. Resistance towards teamwork could be the result of instructors’ lack of experience with TBL. Davidson [15] in 2011 found a stronger preference for active learning in a sequential cohort of medical students, which was attributed to the increasing experience of educators with active learning strategies. Resistance towards teamwork could be tackled by structured team-building exercises, designing discussion-provoking exercises, and expert facilitation skills. Teamwork could also be improved if teams were together longer than 12 weeks; as they appeared to have remained in the phase of storming/forming rather than performing, which might explain students’ resistance.

Our study had some limitations. The number of participants varied across both surveyed courses and in addition, we had a small sample size. Based on our findings, we believe it is important to conduct a larger study to confirm our findings and establish any associations with specific student characteristics. This, in turn, could inform the way teams are formed, which could be crucial for effective team functioning. In addition, it would be useful to determine whether perceptions of teamwork change as students gain more exposure to TBL and to evaluate the impact of specific strategies on the perception of teamwork.

In conclusion, our study showed that students who were exposed to TBL as a novel teaching strategy for the first time favoured it over lectures and found it engaging. Thus, TBL is a strong pedagogical tool that can be used to promote enthusiasm towards learning and to supplement lectures. Resistance to teamwork needs to be tackled by strategies that promote team discussions, which has the potential of enhancing the learning experience.

Authors’ contributions
Conceptualization: PP, BA, AM. Data curation: AM. Formal analysis: AM. Funding acquisition: none. Methodology: AM, PP. Project administration: PP, AM. Visualization: PP, BA, AM. Writing—original draft: AM. Writing—review & editing: AM, PP, BA.

Conflict of interest
No potential conflict of interest relevant to this article was reported.

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Supplementary materials
Supplement 1. Data files are available from https://doi.org/10.7910/DVN/LNW5SMK
Supplement 2. Audio recording of the abstract.

References
1. Michaelsen LK, Sweet M. The essential elements of team-based learning. New Dir Teach Learn 2008;(116):7-27. https://doi.org/10.1002/tl.330
2. Reimschisel T, Herring AL, Huang J, Minor TJ. A systematic review of the published literature on team-based learning in health professions education. Med Teach 2017;39:1227-1237. https://doi.org/10.1080/0142159X.2017.1340636
3. Branney J, Prego-Hernandez J. A mixed methods evaluation of team-based learning for applied pathophysiology in undergraduate nursing education. Nurse Educ Today 2018;61:127-133. https://doi.org/10.1016/j.nedt.2017.11.014
4. Nation LM, Tweddell S, Rutter P. The applicability of a validated team-based learning student assessment instrument to assess United Kingdom pharmacy students’ attitude toward team-based learning. J Educ Eval Health Prof 2016;13:30. https://doi.org/10.3352/jeehp.2016.13.30
5. Greetham M, Ippolito K. Instilling collaborative and reflective practice in engineers: using a team-based learning strategy to prepare students for working in project teams. High Educ Pedag-
6. Mennenga HA. Development and psychometric testing of the Team-Based Learning Student Assessment Instrument. Nurse Educ 2012;37:168-172. https://doi.org/10.1097/NNE.0b013e31825a87cc

7. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods 2007;39:175-191. https://doi.org/10.3758/bf03193146

8. Norman G. Likert scales, levels of measurement and the "laws" of statistics. Adv Health Sci Educ Theory Pract 2010;15:625-632. https://doi.org/10.1007/s10459-010-9222-y

9. Jeno LM, Raaheim A, Kristensen SM, Kristensen KD, Hole TN, Haugland MJ, Mæland S. The relative effect of team-based learning on motivation and learning: a self-determination theory perspective. CBE Life Sci Educ 2017;16:ar59. https://doi.org/10.1187/cbe.17-03-0055

10. Sharma A, Janke KK, Larson A, Peter WS. Understanding the early effects of team-based learning on student accountability and engagement using a three session TBL pilot. Curr Pharm Teach Learn 2017;9:802-807. https://doi.org/10.1016/j.cplt.2017.05.024

11. Livingston B, Lundy M, Harrington S. Physical therapy students’ perceptions of team-based learning in gross anatomy using the Team-Based Learning Student Assessment Instrument. J Educ Eval Health Prof 2014;11:1. https://doi.org/10.3352/jeehp.2014.11.1

12. Parmeelee D, Michaelsen LK, Cook S, Hudes PD. Team-based learning: a practical guide: AMEE guide no. 65. Med Teach 2012;34:e275-e287. https://doi.org/10.3109/0142159X.2012.651179

13. Vasan NS, DeFouw DO, Compton S. Team-based learning in anatomy: an efficient, effective, and economical strategy. Anat Sci Educ 2011;4:333-339. https://doi.org/10.1002/ase.257

14. Obad AS, Peeran AA, Shareef MA, Alsheikh WJ, Kalagi DA, Al-Amodi AA, Khan TA, Shaikh AA, Ganguly P, Yaqinuddin A. Assessment of first-year medical students' perceptions of teaching and learning through team-based learning sessions. Adv Physiol Educ 2016;40:536-542. https://doi.org/10.1152/advan.00001.2016

15. Davidson LK. A 3-year experience implementing blended TBL: active instructional methods can shift student attitudes to learning. Med Teach 2011;33:750-753. https://doi.org/10.3109/0142159X.2011.558948
Appendix 1. The results of the TBL-SAI for accountability, preference for TBL over lectures, and student satisfaction, respectively

### <Accountability>

| Statements                                                                 | Percentage of responses according to 5-point Likert scale (%) |
|---------------------------------------------------------------------------|---------------------------------------------------------------|
| I need to contribute to the team's learning                               | ![Likert scale](chart1.png)                                  |
| I am proud of my ability to assist my team in their learning              | ![Likert scale](chart2.png)                                  |
| I am accountable for my team's learning                                   | ![Likert scale](chart3.png)                                  |
| My team members expect me to assist them in their learning                | ![Likert scale](chart4.png)                                  |
| My contribution to the team is not important                              | ![Likert scale](chart5.png)                                  |
| I contribute to my team members' learning                                 | ![Likert scale](chart6.png)                                  |
| I feel I have to prepare for this class in order to do well               | ![Likert scale](chart7.png)                                  |
| I spend time studying before class in order to be more prepared           | ![Likert scale](chart8.png)                                  |

Numbers within bars represent the frequency of responses for each option of the 5-point Likert scale.

TBL-SAI, Team-Based Learning Student Assessment Instrument; TBL, team-based learning.

### <Preference for TBL over lectures>

| Statements                                                                 | Percentage of responses according to 5-point Likert scale (%) |
|---------------------------------------------------------------------------|---------------------------------------------------------------|
| After listening to a lecture, I find it difficult to remember what the instructor... | ![Likert scale](chart9.png)                                  |
| I do better on exams when we use TBL to cover the material                | ![Likert scale](chart10.png)                                 |
| After working with team-members, I find it difficult to remember what we... | ![Likert scale](chart11.png)                                 |
| I can easily remember material from lectures                              | ![Likert scale](chart12.png)                                 |
| I remember material better following application exercises (revision session) | ![Likert scale](chart13.png)                                 |
| I remember information for longer when I go over it with team members in the... | ![Likert scale](chart14.png)                                 |
| It is easier to study for tests when an instructor has lectured over the material | ![Likert scale](chart15.png)                                 |
| TBL activities help me recall past information                            | ![Likert scale](chart16.png)                                 |
| I remember material better when an instructor lectures about it            | ![Likert scale](chart17.png)                                 |
| I easily remember what I learn when working in a team                     | ![Likert scale](chart18.png)                                 |
| I talk about non-related things during TBL activities                      | ![Likert scale](chart19.png)                                 |
| I get bored during TBL activities                                          | ![Likert scale](chart20.png)                                 |
| I am more likely to fall asleep during lecture than during classes that use TBL activities | ![Likert scale](chart21.png)                                 |
| I am easily distracted during TBL activities                               | ![Likert scale](chart22.png)                                 |
| I am easily distracted during a traditional lecture                        | ![Likert scale](chart23.png)                                 |
| During a traditional lecture, I often find myself thinking of non-related things | ![Likert scale](chart24.png)                                 |

Numbers within bars represent the frequency of responses for each option of the 5-point Likert scale.

TBL, team-based learning.
### <Student satisfaction>

| Statement                                                                 | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---------------------------------------------------------------------------|-------------------|----------|----------------------------|-------|----------------|
| I have had a good experience with TBL activities                          | 2                 | 12       | 33                         | 23    |                |
| I have a positive attitude towards TBL activities                          | 3                 | 10       | 34                         | 22    |                |
| I think TBL activities help improve my grade                              | 4                 | 13       | 35                         | 17    |                |
| TBL activities are a waste of time                                         | 19                |          | 36                         | 11    | 3              |
| TBL activities are fun                                                     | 4                 | 20       | 32                         | 13    |                |
| I do not like to work in teams                                            | 14                |          | 30                         | 21    | 4              |
| I think TBL activities are an effective approach to learning              | 12                |          | 26                         | 29    |                |
| I learn better in a team setting                                          | 3                 | 8        | 20                         | 24    | 15             |
| I enjoy TBL activities                                                     | 6                 | 10       | 30                         | 24    |                |

Numbers within bars represent the frequency of responses for each option of the 5-point Likert scale. TBL, team-based learning.