

Effectiveness of Team-Based Learning in teaching Medical Genetics to Medical Undergraduates

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Abstract

This study explores the experience of both learners and a teacher during a team-based learning (TBL) session. TBL involves active learning that allows medical students to utilise their visual, auditory, writing and kinetic learning styles in order to strengthen their knowledge and retain it for longer, which is important with regard to applying basic sciences in clinical settings. This pilot study explored the effectiveness of TBL in learning medical genetics, and its potential to replace conventional lectures. First-year medical students (n = 194) studying at Universiti Kebangsaan, Malaysia, during 2014/2015 were selected to participate in this study. The topic of 'Mutation and Mutation Analysis' was selected, and the principles of TBL were adhered to during the study. It was found that the students' performance in a group readiness test was better than in individual readiness tests. The effectiveness of TBL was further shown in the examination, during which the marks obtained were tremendously improved. Collective commentaries from both the learners and the teacher recommended TBL as another useful tool in learning medical genetics. Implementation strategies should be advanced for the benefit of future learners and teachers.

Keywords: team-based learning, medical genetics, medical education, biochemistry, flipped learning

Introduction

Team-based learning (TBL) is a current innovation of an interactive flipped learning which direct instruction moves from the group learning space to the individual learning space. This innovation strategically conducted to utilise a limited number of content experts in a faculty. It primarily relies on a teacher to manage numerous small groups in a classroom. TBL has been used as standard practice in several faculties in the United States of America (1–4); however in Malaysia, this method has not yet been fully implemented in tertiary education. Indeed, TBL was only recently adopted in the Faculty of Medicine, Universiti Kebangsaan Malaysia (5), and the Faculty of Education, Universiti Putra Malaysia (6). TBL has received a good response from members of the Faculty of Medicine, Universiti Kebangsaan, Malaysia (UKM), who agreed that the technique is an interactive method of teaching compared to the conventional lecture (5). It is also evident that TBL favours both students and faculty members in learning anatomy which increase students' comprehension and optimise the presence of lack of anatomists in the faculty (7). The principles and application of TBL, as well as its implementation, have significantly influenced

the student-centered learning environment. TBL has four foundations that it is essential to establish prior to conducting an effective TBL session: i) to strategically form a permanent team among students; ii) to ensure student familiarity with course content by utilising a Readiness Assurance Process (i.e. a quiz); iii) to develop students' critical thinking skills by utilising in-class activities and assignments and iv) to create and administer a peer assessment and feedback system (8–10). The present study has focused TBL as supplementary to the current teaching-learning method (concept lecture), and has observed the efficacy of this method and students' knowledge retention by assessing their level of achievement in an examination.

Methods

First-year medical students (n = 194) studying at UKM during 2014/2015 were selected to participate in this pilot study. 'Mutation and Mutational Analysis' was the title chosen for the TBL session, due to its complexity and the lack of content experts who are capable of teaching the subject. This was based on previous examination results, which showed that students cannot differentiate between classes and types

of mutation and the technologies involved in assisting laboratory diagnosis of certain diseases. The learning objectives for this subject were carefully followed, and the materials were prepared accordingly. Videos on ‘Mutation and Mutational Analysis’ were chosen on the basis of the module objectives that it was necessary to achieve. These included how to define mutation; to describe factors that cause mutation; to describe how spontaneous and induced mutations occur; to explain type and group of mutation, using diseases to illustrate the different types; and to explain methods used to detect mutations, the outlines of principles and their importance. It was compulsory for the students to watch suggested lectures on YouTube™ a week prior to the TBL session, and to subsequently submit a mind map via email (Figure 1).

During the TBL session, the students were asked to answer a set of quiz questions to test their understanding of the subject. However, they were first reminded of the learning objectives that it was necessary to achieve. The quiz was conducted in two sessions, and started by an individual readiness test (IRT), in which they were given 15 minutes to complete the questions. In the second session, students were divided into groups of five and a similar set of questions was given to each group. The students were allocated 40 minutes to discuss their answers. In this session, they were permitted to utilise various sources of information, such as the internet, videos, textbooks and their own mind map, during the discussion.

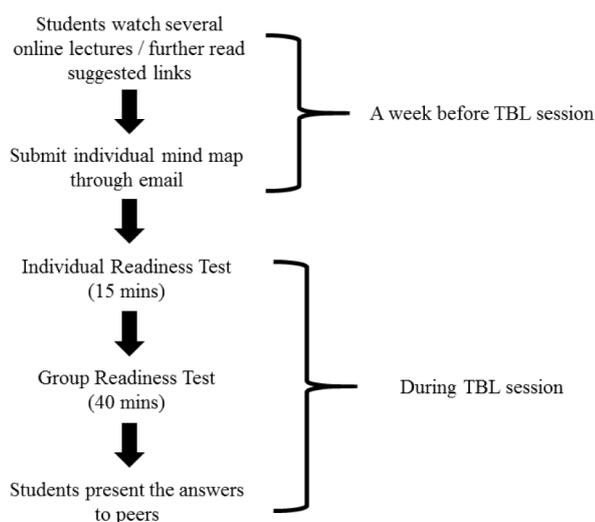


Figure 1: Step-by-step of conducting team-based learning (TBL) session.

Results and Discussion

TBL allows students to incorporate their visual, auditory, writing, and kinaesthetic learning styles to engage with their peers, which helps to explain and share their findings among themselves. The students were also observed to freely discuss with one another. Classroom observation showed that students raised their misunderstanding of the objective of ‘how to differentiate the type and group of mutations and its examples’ through a group discussion. Numerous tools were used to help students to acquire the answers in the group readiness test (GRT). These included the use of tablets, mobile phones, books and their own lecture notes. After approximately 45 minutes of intense discussion, group leaders explained their team’s consensus answers. The teacher further clarified any misunderstandings in the groups, and subsequently provided general feedback on the importance of TBL and the students’ performance in the TBL process (11). At the end of the session, the students participated in a survey to share their initial experiences of learning medical genetics through TBL. Similar responses regarding the benefits of TBL were collated and reported as follows:

‘It’s good that I can communicate with my group and share our knowledge together’

‘It’s good, the tasks made me read and watch the materials again and again. I just have to do a brief reading after the session ends for more understanding’

‘It will be good if all students are brave enough to speak up and share the answers with our peers’

‘I had fun watching the videos provided and it made me want to read further because I want to know more’

‘It was a simple topic, and I managed to finish the task beforehand. TBL should be made on more complex subjects’

‘During TBL, the information can be clarified by the teacher to clear up the misunderstanding’

‘TBL has made me more serious about learning by preparing well before class and it has truly improved my understanding’

'I'm satisfied with the outcome. Any doubt on the subject can be cleared on the spot. I'm also well prepared for the class'

The teacher gained several insightful outcomes from the TBL session. Firstly, a conventional lecture can be replaced using a TBL approach to learning medical genetics. A flipped classroom allows students to be more confident in conveying their ideas, which therefore strengthens their understanding of the subject. This was well reflected in the GRT, in which the percentage of correct answers given was higher than in the IRT (Figure 2). This result is in accordance with a finding by Koles et al. who showed that TBL increased overall academic performance, especially in weaker students (12). In the present study, when the students were further tested, with the objectives 'to explain the class and type of mutation' and 'to relate the classes of mutation with the diseases and genes involved', the class successfully answered the questions given in the 'End of Module' examination, which was held 2 weeks after the TBL session. However, when the students were further tested in the 'End of Semester' examination, the differences in overall marks obtained was not significant, compared to the 'End of Module' examination and the GRT. The plausible explanation for this is that the end of semester examination was held 4 months after

TBL implementation. Thus, the students had to revise prior to the latter examination. However, the increment of marks in both examinations exhibited a significant difference when compared to the IRT.

The data presented here suggest that by grouping the students and giving them tasks before class will influence them, such that they gain better marks. Since a basic principle of mutation was chosen as a part of TBL implementation in medical genetics in the present pilot study, some of the students believed that TBL is more suitable in the application of mutation detection in certain diseases. Therefore, a greater number of quizzes and scenarios must be given earlier to allow them to think outside of the box. Time allocation is also an issue, since a conventional lecture takes only 1 hour, whereas the TBL is usually conducted in 1.5 to 2 hours. Therefore, the teaching and learning system must be properly restructured in future, via the combination of two or three lectures into a session of TBL, hence ensuring that learning is time-efficient.

TBL allows the teacher to better learn by searching for numerous tools to aid in the achievement of the learning objectives. Although the title for this TBL session was rather basic, an integration of a case-based question can be introduced to allow students to truly relate the theory to the actual medical settings. Therefore,

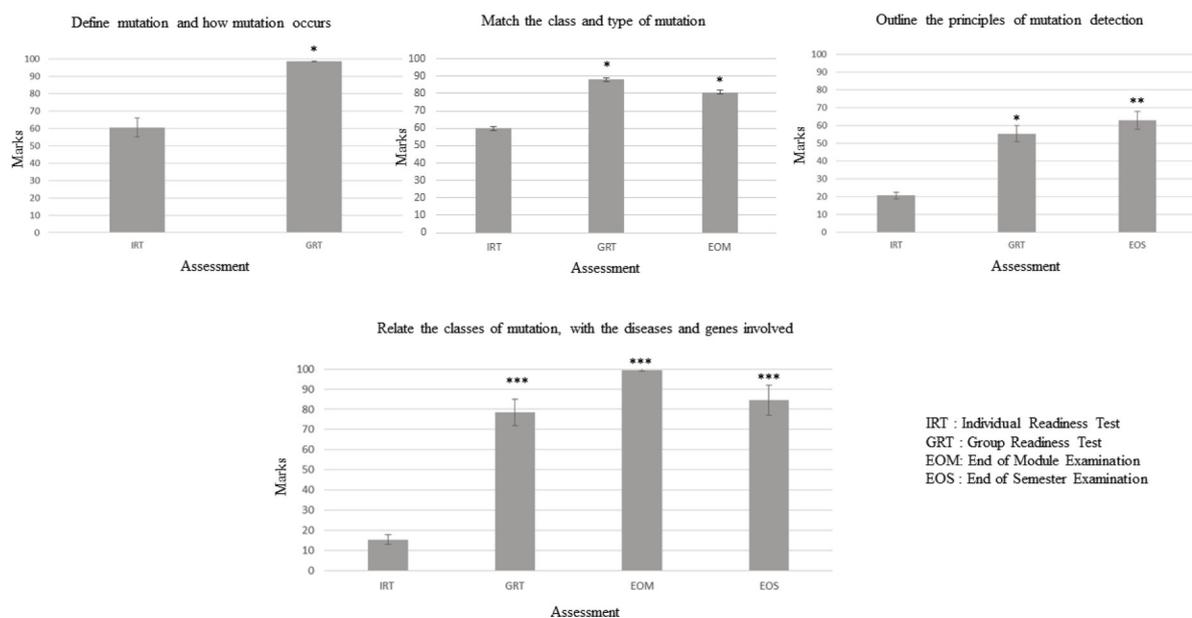


Figure 2: Percentage marks of Year 1 pre-clinical students (n = 194) in different assessments. All data are presented in mean (SD). Asterisks denote any significance differences to the individual readiness test, IRT (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$)

it is wise to combine two or three lectures in a TBL session and allow the students to explore the learning experience by utilising their own visual, auditory, writing, and kinaesthetic learning styles (13). Active learning has proved its efficacy in strengthening knowledge and retaining it for longer, so when the students are in clinical practice, they will be capable of applying the theories to expand their knowledge to another level (14). Problem-solving is a critical technique that must be learned throughout medical experience, therefore TBL can provide a good opportunity to all students, with regard to nurturing their thinking and communication skills, as well as enhancing their mastery of the subject (12,15). A feedback system must be structured, as this will provide satisfaction with regard to learners' experience, as well as motivation to use TBL as a preferable teaching-learning method (16-18).

Conclusion

The implementation of TBL in teaching medical genetics was well received by the students. They were more active in the class, and this was well reflected in their examination marks. This suggests that the TBL strategy can maintain the quality of teaching and achieving learning outcomes. TBL also allows a teacher to manage small groups in a bigger setting, so it may be the answer to the lack of expertise in a given field.

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Conflict of Interest

None.

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