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FLEXIBILITY OF VIRTUAL TEAM-BASED LEARNING IN MEDICAL EDUCATION

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Abstract

Team-based Learning (TBL) is a global educational strategy designed to inculcate self-directed and active learning. There is a new breed of students who are exposed to restricted and compromised teaching and learning methods via online platforms amidst this COVID-19 pandemic. Therefore, this innovation aims to explore the application of active learning among undergraduate medical students through virtual TBL. In this pilot study, the concept of genomics technology is introduced virtually through online platforms, Microsoft Teams™ and Universiti Kebangsaan Malaysia (UKM) Learning Management System (UKMFolio™), while maintaining the principles of TBL. Emphasis is placed on applying the fundamental knowledge learnt during the preparation phase through team discussions and subsequent pitching presentation. Our study revealed no significant difference ($p = 0.404$) in the mean score between students who participated in conventional face-to-face TBL sessions and virtual TBL. This suggests that active and self-directed learning can be integrated through virtual means with reproducible excellent results similar to conventional face-to-face TBL. Nonetheless, issues related to Internet stability and insufficient content experts must be addressed for an effective virtual teaching and learning.
Keywords: education, learning management system, team-based learning, virtual learning.

Abstrak

Pembelajaran berasaskan pasukan (*Team-based Learning*, TBL) merupakan strategi pendidikan yang digunapakai di seluruh dunia untuk memupuk pembelajaran aktif dan pembelajaran secara kendiri. Cabaran sewaktu pandemik COVID-19 telah mengakibatkan masalah pembelajaran secara bersemuka dalam kalangan graduan universiti. Oleh itu, inovasi ini bertujuan untuk meneroka aplikasi pembelajaran aktif dalam kalangan pelajar sarjana muda Program Perubatan melalui TBL secara maya. Dalam kajian rintis ini, konsep teknologi genomik telah diperkenalkan secara maya menerusi sistem aplikasi dalam talian, *Microsoft Teams*™ dan Sistem Pengurusan

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Pembelajaran Universiti Kebangsaan Malaysia (UKM) (*Learning Management System* UKM, UKMFolio™) di samping mengekalkan prinsip-prinsip asas TBL. Pembelajaran berasaskan aplikasi ini menekankan aplikasi pengetahuan asas yang telah dipelajari semasa fasa persediaan (iRAT), perbincangan di dalam pasukan (tRAT) dan seterusnya pembentangan bicara tuntas secara berkumpulan. Kajian kami menunjukkan tiada perbezaan yang signifikan ($p = 0.404$) dalam markah purata antara kumpulan pelajar yang menjalani sesi TBL secara bersemuka dan TBL maya. Ini menunjukkan bahawa pembelajaran aktif dan kendiri dapat dijalankan melalui kaedah maya dan dapat menghasilkan keputusan yang hampir sama seperti TBL bersemuka. Namun begitu, masalah mengenai kestabilan Internet dan pakar yang tidak mencukupi perlu diatasi jika kaedah ini ingin dijalankan dengan jayanya.

Keywords: pendidikan, pembelajaran berasaskan pasukan, pembelajaran secara maya, sistem pengurusan pembelajaran.

1.0 INTRODUCTION

The global undergraduate education system has gradually evolved from conventional teacher-centred to learner-centred curricula (Faezi et al., 2018). Thus, team-based learning (TBL) was first discovered by Michaelsen et al. (1997) for business education, which was subsequently adopted by various disciplines. It is an organised form of learning in small teams that emphasises student accountability for active learning and applies conceptual knowledge through three phases, mainly self-preparation, readiness assurance, and application phase with promising results (Burgess et al., 2014; Najdanovic-Visak, 2017). It is known to be highly learner-centred, with adequate faculty input, while grading, peer assessment, and immediate feedback are integrated to ensure individual and team accountability (Parmelee et al., 2012). This is based on constructivist learning theory, as students are expected to actively expand and construct their own ideas and knowledge based on what they already know, rather than being spoon-fed and passively absorbing the lessons taught (Hrynchak & Batty, 2012).

There are promising academic outcomes when TBLs are organised in an appropriate manner. In fact, studies have shown that academic performance is equivalent or even better than traditional lecture-based or small group-based learning models (Thomas & Bowen, 2011; Zgheib et al., 2010). The entire process of TBL holds everyone accountable for their individual work and contribution to the team, and extensive collegial consultation and discussion takes place to complement each other, ensuring continuous improvement throughout the learning process. It is

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the recommended teaching and learning approach specifically for health sciences education (Parmelee et al., 2012). The sheer amount of knowledge in any medical field is advancing rapidly, making memorization alone impractical and expecting students to be lifelong learners capable of assessing the ongoing wealth of health discoveries. In medical education, for example, studies from various universities around the world have found that supplementary TBL efficaciously helped students to improve in their medical clerkships especially in terms of clinical reasoning compared to conventional teaching and learning methods (Cevik et al., 2019; Kaminski et al., 2019; Xu et al., 2021). The uniqueness of this approach has therefore been used in various fields through simulations of real-life scenarios, such as business (Chad, 2012), engineering (Najdanovic-Visak, 2017), and law (Sparrow & McCabe, 2012), and has shown similarly promising results.

TBL's only concern is its ability and effectiveness in large groups of students, especially when content experts are inadequate to address student concerns (Burgess et al., 2014). Indeed, with the current COVID -19 pandemic afflicting the education sector, the outcomes of teaching and learning through virtual platforms, especially the feasibility of virtual TBL behaviour, have remained a topic of concern. Therefore, this study aims to develop a brand new virtual TBL to support the application of self-directed and active learning among students.

2.0 MATERIALS AND METHODS

2.1 Study Design, Study Setting and Study Population

This was a cross-sectional study involving Year 1 undergraduate medical students Universiti Kebangsaan Malaysia (UKM). All UKM Year 1 medical students in the current year 2020/2021 and the previous year 2019/2020 were eligible to participate in this study. Participation in this study was voluntary and respondents had the right to withdraw from this study. Informed consent was obtained and all data was confidential and limited only to the researchers involved in this study. Students from other years of study and who did not consent to participate in this study were all excluded. This study has obtained an ethics approval under code FF-2014-260.

2.2 Sampling Process

Purposive sampling was used, with all Year 1 UKM undergraduate medical students in both the 2020/2021 and 2019/2020 cohorts included in this study. The target sample size is 286, which was determined by identifying the smallest acceptable demographic subgroup, where in this

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situation the population size of our medical school at UKM is 1000, with a margin of error of ±5% and a confidence level of 95%. There was a total of 311 respondents consisting of 160 and 151 UKM medical students in the 2020/2021 cohort who experienced virtual TBL and the 2019/2020 session of conventional TBL respectively.

2.3 Procedure and Data Analysis

Human Genetics is one of the compulsory modules for all Year 1 medical students at UKM. Based on the conventional TBL principles, the concept of genomics technology is taught through Microsoft Teams™ and UKM Learning Management System (UKMFolio™) to substitute the conventional method of TBL, Figure 1. The virtual TBL was conducted during March 2021. The initial preparation phase was similar for both the conventional and virtual TBL, with self-directed learning implemented in the preparation phase through the creation of mind maps. The subsequent individual readiness test (iRAT) was administered virtually through a more environmentally friendly online quiz with live score boards that were sorted by correct answers compared to the previous printed questions. Since students could not meet face-to-face for quiz discussions during the team readiness assurance test (tRAT), it was modified into experiment formulation discussions using breakout rooms in Microsoft Teams™, followed by recorded team pitching sessions. The content expert would then review the recordings and provide feedback, followed by question-and-answer sessions. Finally, students were provided with case-based scenarios to assess their core understanding of the topic. Students were also asked to provide feedback at the end of the TBL session via a dedicated area in UKMFolio™. The outcome of TBL was assessed through the end-of-semester examination, which consisted of Key Featured Questions. The standards of the examination questions were maintained by the UKM vetting committee which consisted of various content experts, to ensure that the quality of the assessment was not compromised. Results were recorded using Statistical Package for Social Science (SPSS) Version 22 and statistical significance level was set at $p = 0.05$(*), $p = 0.01$(**) and $p = 0.001$(***). A t-test was used to determine the difference between final exam scores between virtual and conventional TBL batches of students.

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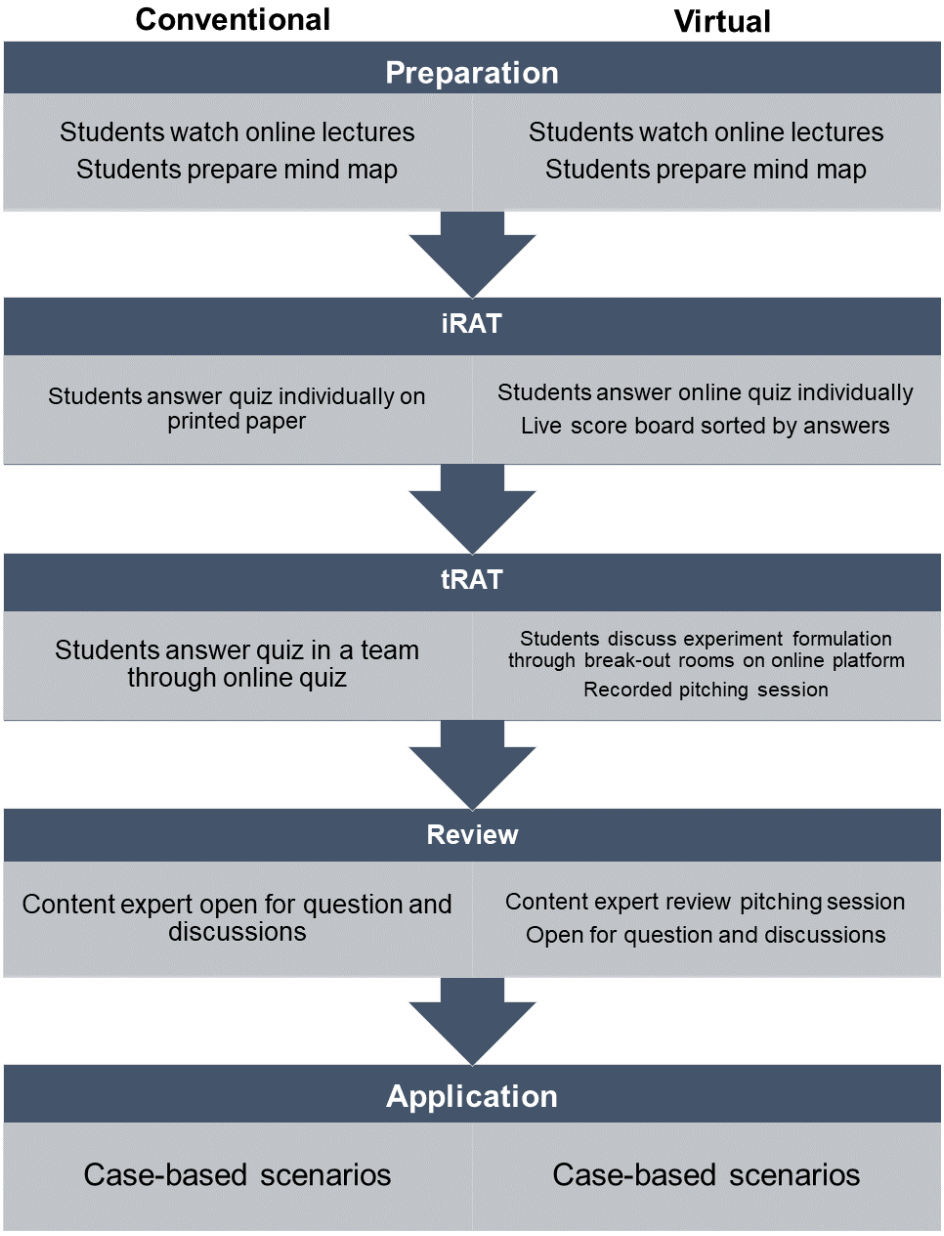

Figure 1. Comparison of Conventional TBL vs Virtual TBL

3.0 RESULTS AND DISCUSSION

3.1 Statistical Results

The samples were normally distributed, with a greater proportion of females in both cohorts, Figure 2. Upon t-test, there was no significant difference (p=0.404) in the mean score on the final exam between conventional and virtual TBL, Figure 3. When we further scrutinized the mean score for each question, the virtual cohort scored the same with the conventional cohort. Recent

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studies comparing conventional and virtual TBL found similar results where students performed equally well on the exams but expressed a preference for conventional TBL (DeMasi et al., 2019; Jackson et al., 2020). Negative perceptions were mainly attributed to a lack of familiarity with the online platform (DeMasi et al., 2019). This could apply to our study population, as they were first-year medical students who had just entered medical school and were still adjusting to medical teaching and learning approaches.

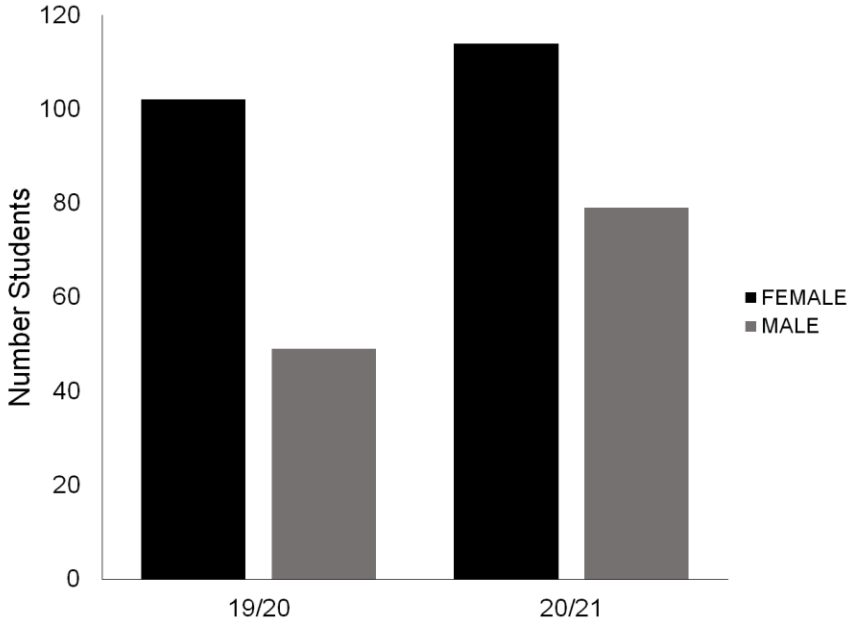

Figure 2. Number of Students by Gender and Study Session

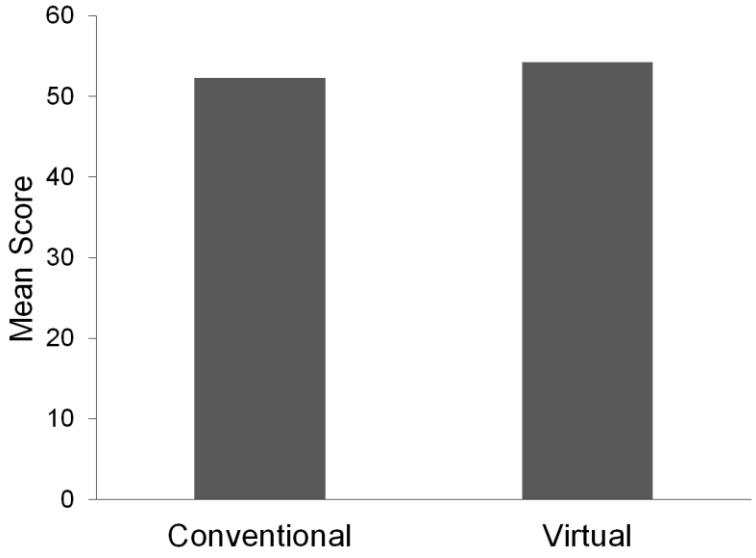

Figure 3. Comparison of Mean Score Between Learning Methods

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However, students generally had positive perceptions towards virtual TBL with three main themes highlighted by the students as below.

3.2 Themes of Feedback

Theme 1: Teamwork

Students emphasized the importance of teamwork, which provided a new way of learning a topic and facilitated the recognition of question patterns and subsequent correlations with real-world scenarios.

> *"Teamwork is important."*
> *"This is a new way to learn a new topic and can easily understand the pattern and correlation of questions with group discussions."*
> *"Gain experience of working in a group."*

Indeed, TBL is a learning approach that emphasizes teamwork (Ismail, 2016), and in our study setting, students must collaborate in brainstorming and problem solving during the formulation of the experiment and pitching presentation during the tRAT phase. It has been proven that the team with the worst performance usually still performs better than the best individual student, which emphasizes the importance of teamwork (Michaelsen & Sweet, 2008). Collaborative work complements different learning types based on the VARK model of learning styles; visual, auditory, reading/writing, and kinaesthetic to subsequently achieve the intended learning outcomes collaboratively (Li et al., 2019). In addition, students indirectly develop professional attributes by giving and receiving feedback during group discussions. The ability to provide feedback can improve communication skills, problem solving, and critical thinking while providing an active learning experience by becoming a reflective learner through receiving feedback (Burgess & Mellis, 2015).

Theme 2: New Knowledge

Students were motivated to search for more information on genomics technology, especially in formulating a new experiment in search of a new anti-cancer drug using different omics technologies. This could stimulate and enhance self-directed learning and instil students' research interest.

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"Learn new diseases and their mutations"

"Learn how to apply the knowledge on mutation and omic to develop anticancer drug"

TBL encourages in-depth study of topics during discussion-based learning. The learning environment in TBL supports active discussions and group-based interactions and promotes extrinsic motivation towards a positive attitude towards learning (Nashruddin et al., 2018). This encourages students to explore more on relevant topics and obtain new relevant information outside the classroom, thus encouraging students to keep up with the latest research. Similarly, for social studies students, students with high or moderate pre-test scores benefited from TBL (Wanzek et al., 2014), suggesting that students need to prepare thoroughly before the session to gain utmost benefits. Improvement in knowledge and performance also applies to nursing students where knowledge and clinical performance with standardized patients showed improvement for those who underwent TBL (Kim et al., 2016). This shows that TBL methods are universally applicable in different study areas to promote knowledge seeking behaviour.

Theme 3: Lifelong Learning

Virtual TBL promotes lifelong learning skills in medical students by looking at different aspects of their life. With the concept of solving challenging real-world problems that begin with learning basic knowledge related to the basic sciences (Haidet & Fecile, 2006), students can, for example, use Human Genetic module to think about the impact of lifestyle and the environment on their DNA that could lead to later health outcomes via the TBL learning method.

"Learn how to use several technologies to detect gene mutation."

"Learn the relation between type of mutation and disease."

By instilling the value of lifelong learning, students can reinforce and create public awareness of the role of genetics in diseases and the use of genomic analysis as a diagnostic tool. With the introduction of TBL in the Human Genetics module, students were given the opportunity to apply self-directed learning and learn to keep themselves updated with the latest knowledge and skills through directed interaction.

"Early screening for any genetic diseases present in the family."

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"Some of the genetic diseases are also due to environment and lifestyle, so I think I should avoid these harmful factors."

"Consume less processed food as it contains a lot of preservatives which are mutagens."

This is transferable to other fields of study to apply the fundamental knowledge to real-life scenarios such as cancer (Haidet & Fecile, 2006), diagnostic imaging (Tsai & Jao, 2020), and nursing (Kim et al., 2016). This allows students to have substantial fundamental knowledge while applying it to their future careers.

However, two main issues, mainly the stability of the Internet and insufficient content experts, were the major challenges in conducting effective virtual TBL sessions.

Issue 1: Internet stability

Internet connectivity is the biggest challenge UKM students face throughout their studies (Ming et al., 2012). In fact, 40% of our medical students have a poor Internet connection (<5Mbps). The students' concerns during the virtual TBL sessions were mainly the poor Internet connection that refrained them from switching on the camera to maintain social presence during team-based discussions. Social presence is a vital aspect of virtual learning, described as one's perceptions of the presence of others (Akcaoglu & Lee, 2016). In virtual learning, especially the asynchronous type, it has been argued that social presence is lacking due to physical separation and insufficient synchrony of communication (Sung & Mayer, 2012). Therefore, a stable Internet connection to support synchronous virtual TBL is important to provide and maintain social presence through active social interaction so that learning outcomes and student satisfaction are achieved.

We suggest that UKM and the faculty could improve the stability and reliability of the Internet connection. The initiative by UKM and YTL Communications to provide a free 40GB data connection to every UKM student during the pandemic period should be continued to avoid infrastructure problems hindering virtual learning. An appropriate mix of synchronous and asynchronous methods could also help overcome this problem.

Issue 2: Inadequate content experts

In our study setting, only one content expert was available to administer the implementation of the virtual TBL. Therefore, it would be tedious to maintain teaching presence, especially to support

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discussions and address student concerns that arose during the session in all breakout rooms in Microsoft Teams™. Even though the role of the content expert is mainly that of a facilitator, it is still important to ensure that students stay on track. Teaching presence consists of three main roles, mainly designing and organizing the learning module, conducting and monitoring the sessions to ensure active discussions, and contributing expert opinions and experiences during question-and-answer sessions (Preisman, 2014). Insufficient content experts has been one of the key barriers in implementing TBL (Burgess et al., 2020). With these important roles, we need adequate content experts to ensure smooth delivery of TBL to large groups of students. But if there is a lack of content experts, a few facilitating instructors can be added to facilitate the process of team-readiness assurance test (Whiteley et al., 2015; Rotgans et al., 2018, Rajalingam et al. 2018). This crushing disproportion in the ratio of students to content experts can be improved by recruiting tutors from senior students. Also, by using the asynchronous method, the amount of work can be distributed over a more generous time frame.

4.0 CONCLUSION

TBL content and structures can be fully transformed into a virtual environment from a conventional face-to-face environment to a virtual environment. The integrity of TBL is proven to be maintained and enhanced through a student-centred learning process with the addition of social presence across all available online platforms. Despite the geographic limitation during this pandemic, students are still able to complete their curriculum requirements and stay connected with their peers during virtual TBL. Therefore, continuous efforts and improvements should be made to overcome the hurdles and support the application of the TBL concept in a virtual learning environment.

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