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Original article

Comparison between flipped classroom and team-based learning in fixed prosthodontic education

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ABSTRACT

Purpose: We previously investigated the effects of team-based learning (TBL) on fixed prosthodontic education and reported that TBL could have higher efficiency with high student satisfaction than traditional lecture. In the current report, we introduced flipped classroom to the fixed prosthodontic education and compared their effectiveness based on the final examination score in addition to TBL.

Methods: Participants were 41 students from Tokushima University School of Dentistry who attended a fixed prosthodontics course. The first six classes adopted the flipped classroom style while the latter eight classes adopted TBL. To evaluate the relationship between learning styles and their effectiveness, we compared results from the term-end examination between the curriculum covered by flipped classroom and TBL-style classes. To draw comparisons, a referential examination with the same questions was conducted to eight faculty members who had not attended any of these classes.

Results: Term-end examination results showed that TBL classes had slightly higher scores than flipped classroom classes. Referential examination results also showed higher scores for the same curriculum and no significant interaction was found between class formats and the term-end and referential examination scores. Analysis revealed no noticeable difference in the effectiveness of the class formats.

Conclusion: Our previous study reported that TBL had higher efficiency than traditional style lecture. In the current study, there was no statistical difference in the examination score between flipped classroom and TBL. Therefore, we conclude that both styles are highly effective than traditional style lecture and constitute valid formats for clinical dental education.

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1. Introduction

Active learning is an instructional method that requires students to search for questions and solve problems by themselves [1]. Classes employing active learning involve a variety of techniques such as problem-based learning (PBL), team-based learning (TBL) and flipped classroom [2–15]. PBL is typically performed in small classes and the tutor assigned to the class observes and assists in the group discussion [2]. For classes with a large number of students, TBL is more efficient as class members are divided into several teams to develop intra- and inter-group discussions [3–8]. We have conducted TBL in prosthodontic education in 2013 and reported that TBL promotes study preparation and an active student attitude. TBL is a potentially more effective method of teaching than the usual style of classes [7,8]. In that report, the term-end examination results showed significantly higher scores on the questions that covered the TBL-class material than those that had covered the traditional lecture-class topics.

Currently, the increasing use of personal computers and mobile information platforms such as smartphones and tablet computers are reducing the information gap between each student. The development of these information and communication technologies has resulted in e-learning becoming part of higher education in many fields [9–11]. Flipped classroom is one of the blended learning methodologies that combine e-learning and face-to-face classroom technique. Typically, students first prepare for the classes by watching videos and subsequently, instead of a passive-style lecture, receive individual instruction and workshops that are conducted in the classroom [13].

The advantages of these new learning methods have been widely researched, usually through questionnaires and/or examination results surveys [2–8,14–16]. However, little research has compared the effectiveness of the different active learning methods. Our study aimed to evaluate and compare the quality of flipped classroom and TBL in prosthodontic education for fourth-year students at University School of Dentistry. Flipped classroom and TBL-style classes were both held during a semester on a fixed prosthodontics course and term-end examination performances were used to evaluate the effectiveness of the methods.

2. Materials and methods

This study was approved by the Research Ethics Committee of Tokushima University Hospital (No. 1893). For the study, 41 fourth-year students (13 males and 28 females) at the Tokushima University School of Dentistry attended the fixed prosthodontic course. Fourteen classes were held: the first six classes adopted the flipped classroom style while the latter eight classes adopted TBL. The TBL class used printed handouts for preparatory study and students have to receive these materials before the classes. The order of the TBL class was arranged after the flipped classroom in which e-learning system was adopted for preparatory study. In the initial flipped classroom and TBL class, introduction of the class formats and instructions for the study preparation were performed with visual aids through a video projector. Each class was 60 min in length.

Fig. 1 presents a summarized schema of the flipped classroom and TBL classes. Before attending the flipped classroom classes, students were provided with the teaching materials through the e-learning system. Students accessed the e-learning system using their own ID and password and prepared for the classes at home using a personal computer and/or smartphone. The progress of each student's preparation was confirmed by multiple-choice questions that had been developed using Moodle (http://Moodle.org/) in the Tokushima University Learning Management System (LMS). Five questions were assigned to each class, and students could check their test scores immediately after uploading their answers. However, they could not ascertain the correct answers until the actual class. This preparatory test was performed within one week or one day prior to each class. Before the class, the teacher reviewed each student's score and calculated the percentage of correct answers for each question. At the beginning of the class, the teacher gave feedback to the students about the questions and subsequently provided an explanation of the teaching materials and individual instruction.

Details of the instruction for TBL format were described in our previous report [7,8]. In summary, when starting TBL classes, students were given a preparatory handout for their home study, one week before each TBL class. At the beginning of each TBL class, students underwent an individual readiness assurance test (IRAT) in multiple-choice format to check their preparation level. Students were then divided into small teams of six or seven and took the group readiness assurance test (GRAT) after the group discussion, which had the same questions as the IRAT. Following teacher feedback with regard to the IRAT and GRAT questions, the students were given group assignment projects (GAPs), which involved clinical practical questions to test the students' ability to apply their learning to difficult clinical situations. Each group then presented its GAP findings to the class using number boards. Finally, a peer evaluation was performed by each student and scores were given to each of their group members.

The effectiveness of the flipped classroom and TBL was assessed from the results of the term-end examination. Forty-seven multiple-choice questions, which included 23 questions from the flipped classroom and 24 questions from the TBL, were included in the examination. A referential examination with the same questions was given to eight dentists who belonged to the Department of Stomatognathic Function and Occlusal Reconstruction, Tokushima University. The average age of these dentists was 30.9 ± 5.7 year old with more than two years clinical experience and none of them had attended any of these classes. The correct answer ratios for each question were calculated from the term-end and referential examinations and a two-way analysis of variance with two factors, class format and examinees, was conducted to evaluate the interaction between those factors.

Besides the examination records, a student evaluation questionnaire for the e-learning and flipped classroom was conducted at end of the first six flipped classroom classes

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