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Removable Partial Denture Components and Applications: A Team-Based Learning Module

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Abstract

Introduction: The process of learning the removable partial denture (RPD) requires that students first acquire fundamental concepts and then use critical thinking skills to apply that knowledge to different clinical scenarios. We believed this course posed a perfect opportunity to transition to an active learning method, namely team-based learning (TBL). **Methods:** In each TBL session the instructor creates adequate teams and assigns reading materials to the students in preparation for the readiness assurance process. While in class, individual students complete a case-based, multiple-choice examination to ensure their readiness to apply their foundational knowledge. Once all individual members of each team complete their individual tests, they retake the same examination as a team. During this process, they must reach consensus on their answers, which promotes discussion, debate, and learning. This module also presents an application assignment. Every team is presented with the same significant problem, is asked to come up with a specific answer, and reports simultaneously with the other teams, which results in a productive and vigorous debate. **Results:** The shift to the TBL format resulted in a lower quantitative overall course evaluation compared to prior years, yet paradoxically, students' comments reflected a change in their attitudes and knowledge gain. From an administrative perspective, the shift added substantial value since there were 2 fewer hours of student class contact time and 98 fewer hours of faculty time assigned to the course. **Discussion:** The RPD course transition to active learning was supported by our College Curriculum Committee goals. Placing the responsibility for learning on the student enhances his/her learning ability and allows time for instructors to teach at another level.

Keywords

TBL, Team-Based Learning, Assessment, Denture, Prosthodontics, Critical Thinking, Curriculum Development, Preclinical Education, Removable Partial Dentures, Partial, Removable

Educational Objectives

By the conclusion of this module, students will be able to:

1. Classify the case according to the removable partial denture (RPD) Kennedy classification.
2. Explain the biomechanical classification of RPDs.
3. Design an appropriate RPD framework and justify the choice of design.
4. Describe the components of a clasp assembly and their individual functions.
5. Indicate the ideal form and location of arms for different types of direct retainers and describe the indications and contraindications of each.
6. Differentiate the design philosophies between distal extension and tooth-supported RPDs.

Introduction

TBL methodology (see [Figure](#)), which relies on active student participation, is employed to improve student ability to apply the principles learned to treatment plan and design a removable partial denture (RPD).

Appendices

- A. RAT Form.pdf
- B. Readiness Assurance Test .doc
- C. Appealing Form.pdf
- D. Application Assignment.doc
- E. Odontogram.pdf
- F. RPD Design and Work Authorization Form.pdf
- G. Application Exam Form.pdf
- H. Review Lecture.pdf

All appendices are peer reviewed as integral parts of the Original Publication.

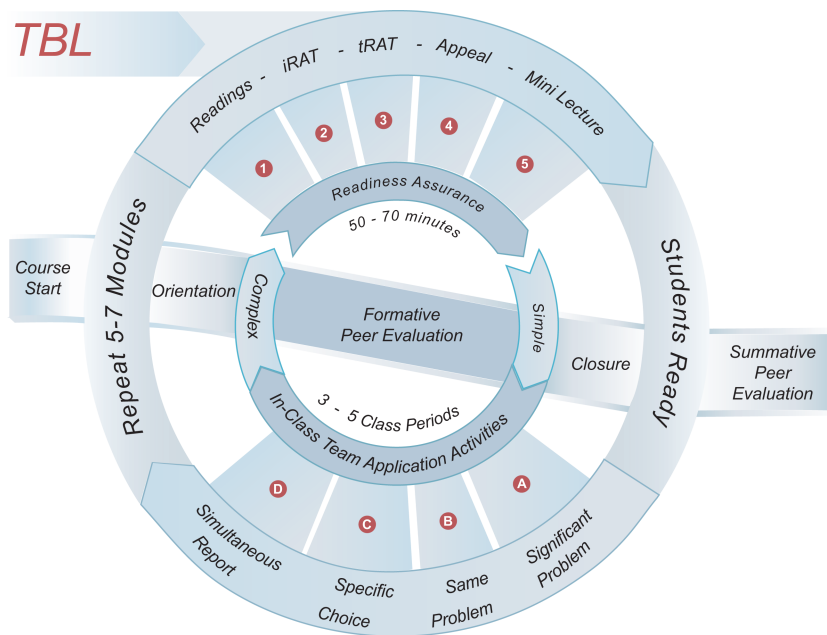


Figure. Team-based learning methodology. Illustration by Jim Sibley and Sophie Spiridonoff at the University of British Columbia. Used with permission. iRAT, individual Readiness Assurance Test; tRAT, team Readiness Assurance Test.

A recent study by Echeto et al.¹ indicated that the TBL methodology had a positive and statistically significant impact in the students' learning outcomes, knowledge retention, and ability to evaluate, diagnose, and treatment plan a partially edentulous patient with an RPD prosthesis. The results showed that students who learned RPD with TBL methodology scored statistically significantly higher (71.8%) on a written examination compared to those who learned RPD through traditional methods (48.1%). The proportion of passing grades was statistically significant ($p = 0.002$), and 23.7% more students passed the examination. The mean score for the TBL class (.758) compared to the conventional class (.700) was statistically significant, with a large effect size, also demonstrating the practical significance of the findings. The results of the study suggest that TBL methodology is a promising approach to teaching RPD with successful outcomes.

This module is a combination of the first three subject areas of the preclinical course entitled Removable Partial Prosthodontics: Principles & Techniques intended for third-year dental students. This module presents the first Readiness Assurance Test (RAT) and application assignment that cover the foundational knowledge of RPD. The three subjects include Kennedy classification, RPD biomechanical concepts, and RPD components.

The full preclinical course is divided into 14 RPD topics with specific objectives. These topics are covered via readiness assurance processes (RAPs) and in-class application assignments, which include hands-on RPD design activities and psychomotor assignments on given cases, such as survey and tripod procedures, custom tray fabrication, record bases and wax rims construction for mounting procedures, RPD mouth preparations, final impressions techniques, fabrication of the master casts, metal framework try-in, and records and teeth setting.

Methods

The instructor creates teams of six to seven students by ranking the class based on GPAs. Once the class is ranked, the best scores, worst scores, and median scores are evenly distributed among all of the teams. At the end, each of the teams should have a variety of individuals with different knowledge bases and psychomotor skills.

Students are given a series of objectives and reading assignments as part of their individual preparation outside class. For this module, the students must review a provided review lecture (Appendix H) and study the following chapters of the assigned book, *Stewart's Clinical Removable Partial Prosthodontics*, fourth edition²:

1. Chapter 1: RPD Concepts and Kennedy Classification (pp. 1-18).
2. Chapter 2: Major and Minor Connectors (pp. 19-49).
3. Chapter 3: Direct and Indirect Retainers (pp. 51-94).

While in class, individual students have to complete a multiple-choice examination that consists of eight case-based questions to ensure their readiness to apply their knowledge. They must use the RAT form (Appendix A) when answering the questions. This form consists of a copy-form with two sheets. As stated in the form instructions, each question is worth 4 points. Students should assign a total of 4 points on each line. If they are uncertain about the correct answer, they may assign points to more than one box (e.g., 2 points to choice A and 2 points to choice C). Once all individual members of the team have completed their individual RAT (iRAT; Appendix B), they must retake the same examination as a team: the team RAT (tRAT). A team representative turns in the original answer sheet of the RAT form to the instructor and keeps the students' copy for the team's discussion. The instructor gives the team representative the Immediate Feedback Assessment Technique (IF-AT) card for immediate scoring during the tRAT. Students are not allowed to use any supporting documentation or cellphones during the whole RAP. However, during this process, they must reach consensus on their answers, which in and of itself promotes discussion, debate, and learning.

Once the team members decide what the right answer is, they have to scratch off the IF-AT card for immediate scoring. Each time the team does not find the correct answer, it loses points and has to return to the question for further discussion and consensus until discovering the right answer. One scratch = 4 points, two scratches = 2 points, three scratches = 1 point, and four scratches = 0 points.

Following the tRAT, the teams should be encouraged to appeal incorrect answers, which pushes the team back into discussions and review of the reading material. An appeals form (Appendix C) is required to be filled out with the rationale of their answers and understanding of the concepts. If their explanation is appropriate, all 4 points are granted to the tRAT and all iRATs with the same answer as the team appeal. It is important to mention that individual appealing is not allowed. All of the members need to agree on an answer and complete the form as required. Once the appeals process is completed, the instructor provides a targeted mini-lecture on the most troublesome concepts to clarify any confusion.

The application examination presented in this module consists of an open-book assignment in which the team discusses and solves a relevant clinical scenario. The case includes the written scenario (Appendix D) and the corresponding odontogram (Appendix E). Each member of the team is required to evaluate the case, fill out the work authorization form (Appendix F), and contribute to the team assignment. This activity promotes critical evaluation, collaboration, use of their knowledge, accountability, and identification of deficiencies. At the 60-minute deadline, the teams are required to turn in their answer sheet (Appendix G) and get prepared for the simultaneous reporting and discussion moderated by the instructor. This application assignment follows Michaelson's 4S principle (significant problem, same problem, specific choice, and simultaneous report).³⁻⁶ This assignment gives the individuals, the teams, and the entire class opportunities to discuss the case and receive feedback on the specifics of their rationale. The simultaneous reporting allows students to engage with a diverse set of perspectives and approaches to problem solving and treatment planning of RPDs.

During the RAP, the students are given 40 minutes to complete both the iRAT and the tRAT. Following the tRAT, the teams are encouraged, if desired, to appeal incorrect answers, which pushes the team back into discussions and review of the reading material for the following 10 minutes. Once the appeal process is completed, the instructor provides a targeted 15- to 20-minute mini-lecture on the most troublesome concepts to clarify any confusion.

During the presented application assignment, students are given 60 minutes to complete the assignment, followed by the immediate reporting and discussion for 20 minutes.

Results

The use of TBL methodology, which is focused on active student participation, was employed to improve student ability to apply principles learned to treatment plan and design an RPD. Instructional time was reallocated from a traditional 14-lecture-hour and 33-lab-hour experience to a TBL design that included two lectures (decrease of 12 lecture hours), 18 lab hours (decrease of 15 lab hours) and ten 2.5-hour, in-class application assignments (increase of 25 hours for a net decrease of 2 contact hours). Faculty assignments were also decreased from four faculty covering 33 hours of simulation lab activities to two faculty covering the eight TBL application assignments. The TBL methodology required active participation of the students in groups and needed fewer faculty to facilitate.

The results of this revised preclinical course were evaluated through several means. Two faculty from other disciplines provided peer observations of the teams and described their findings thus: “students were actively engaged in teaching each other and working toward consensus in designing their assigned RPD treatment plan,” and “students asked process and clarification questions rather than content questions.”

The quality of student comments from previous and current course evaluations was also examined, with comments changing from “she is an excellent teacher” to “I learned how to defend my answers better and reason through things” and “there are many ways to deal with the same case and it is important to think critically on every case.” Paradoxically, overall numerical course evaluations decreased with the new course design ($M = 3.5/5.0$) compared with the previous design ($M = 4.7/5.0$). There were no significant differences in final student course grades, yet the average score for the iRAT was 83% and for the tRAT, 99%.

Students responded to the following critical thinking questions:

- “Found myself actively engaged in thinking about difficult questions for which we still need to find answers”—88% reported *agree*, and 12% reported *disagree*.
- “The assignments forced me to think things through in order to determine what to believe or do in a given situation”—93% reported *agree*, and 7% reported *disagree*.

This course revision, which transitioned to active learning, was supported by our College Curriculum Committee goals. Placing the onus for learning on the students resulted in a lower quantitative overall course evaluation, yet paradoxically, student comments reflected a change in student attitudes, with many students expressing their knowledge gain and their ability to think through and make clinical decisions. Additionally, there was administrative value added with the course revision. There were 2 fewer hours of student class contact time and 98 fewer hours of faculty time assigned to the course.

Discussion

The RPD topic is a difficult and challenging area of prosthodontics where more than one design will be acceptable. Biomechanical, anatomical, and scientific knowledge is necessary for a successful outcome of this treatment. The dentist must use his/her knowledge base and critical thinking skills over a wide variety of patient care situations. A lecture-based course has been proven to be ineffective for getting the students to understand this area, as reflected in students’ senior exit interviews and course evaluations. Current health science educational research supports the use of active learning, like TBL, to motivate and engage students to learn. This information prompted faculty members to consider the use of TBL methodology to improve students’ level of understanding in RPD treatment.

This RPD preclinical course revision took approximately 4 weeks for the initial planning and continuous changes as the course moved along. The RATs and application examinations were developed throughout the course. It took approximately 4 hours to create a five- to eight-question RAT or a clinical scenario for the application examinations. It is critical that these tests and applications are well constructed so that they

can promote students' interactions, exchange of knowledge during the team tRATs, and resolution of the applications assignments, and result in knowledge gain.

At the beginning of the course, the students were uncomfortable with the new teaching style. Some students gained confidence quicker than others since they had different ways of learning. All students felt more responsible to prepare for class as they knew their team success depended upon them. Additionally, quiet and shy students were motivated to participate when they demonstrated they had the correct answers and knowledge. On the other hand, students used to leading discussions and projects were impressed by others who might know different, accurate, and complementary information. Students admitted that they were actively engaged in finding answers for difficult questions during team activities. Placing the responsibility for learning on the students enhanced their learning ability and allowed more time for the instructors to teach the students at another level. The discussions were very active, and students were motivated to attend class, participate, and be challenged with different scenarios.

At the end of the course, all students demonstrated a deep understanding of the RPD treatment and were well prepared to design RPDs in a wide variety of clinical scenarios. They expressed that team activities improved their ability to reason through complex problems as they had to explain to peers their findings and solutions. With the use of TBL methodology, the students were more actively engaged than in traditionally taught RPD, and fewer faculty members were needed to teach course content and lead the discussions.

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Ethical Approval

Reported as not applicable.

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