Combining learning strategies for developing abilities and competencies in a preclinical Removable Partial Denture course: an experience report

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ABSTRACT

Active methodologies in dental education have been highly recommended by the National Curricular Guidelines in developing students' abilities and competency, and directly impact on the reflective capacity of new professionals. Some studies on Removable Partial Dentures (RPD) have pointed out benefits of the student-centered method by using different strategies such as Problem-Based Learning (PBL), Case-Based Learning (CBL) and Team-Based Learning (TBL), with positive results in the teaching and learning processes. This article aims to report the experience of using active methodologies such as CBL, Inverted Classroom and Brainstorming techniques as a strategy in the RPD Preclinical Course of the Federal University of Paraíba, focusing on the development of students' critical thinking for planning partial edentulous arches. As a result of this change, instructional materials such as a checklist of questions and a flowchart were developed and have started to be implemented as important tools during the laboratory classes. Adapting teaching strategies with the active participation of students can be a valuable tool to verify difficulties during prosthesis planning. As a result, it can improve self-confidence in determining the mechanical components prior to clinical care. The instructional materials developed can help professors to reflect on different forms of methodologies in RPD teaching and insert students in their own knowledge construction.

Descriptors: Education, Dental. Denture, Partial, Removable. Learning.

1 INTRODUCTION

Removable Partial Dentures (RPD) are a widely used therapeutic modality for rehabilitation in partially edentulous patients, especially in countries such as Brazil, where the prevalence of edentulism is still high[1] and

influenced by economic, social and cultural aspects of the population[2,3]. Therefore, dental students must learn the basic concepts and train their technical skills, but above all, develop competence for RPD planning during their undergraduate training, and be able to rehabilitate their patients as soon as they start working. This lack of integration between theoretical learning and practical training has already been pointed out as a negative aspect by dentist graduates[4], which highlights the importance of practical training for solidifying theoretical learning in the various curricular components.

This is no different for RPD, as taking the course may be a challenge for undergraduates given the great diversity of new concepts presented and the difficulty in applying all of the theoretical knowledge in the consolidation phase and in planning partially edentulous arches. In addition, other curricular components of Prosthodontics are normally studied simultaneously and can make the learning process more complex. Teaching RPD is generally based on the traditional model centered on the teacher, which makes it difficult to develop the connection between theory and practice, but which is fundamental and effective for courses in the health area[5]. In changing the teaching strategy to an active methodology, the student becomes the center of the educational process and information is shared between the teacher and students[6]. This fact could result in stimulating critical thinking, developing skills, and consequently improving professional performance.

Encouraging student participation and critical thinking can be initiated in the pre-clinical Prosthodontic courses by using active methodologies, thereby impacting better sedimentation of fundamental concepts[7]. Integrating interdisciplinary knowledge in RPD with a wide variety of concepts and components presented can make it difficult to develop the correct sequence of the treatment plan, as well as influence the correct selection of mechanical components[8]. Some studies have demonstrated the benefits of active methodologies such as Problem-Based Learning (PBL), Case-Based Learning (CBL) and Team-Based Learning (TBL) in teaching RPD compared to the traditional methodology, with positive evaluation in the results of learning and student preference[8-11]. Initially associating active methodology techniques with other learning strategies can bring benefits and be easily added to the traditional teaching model. For example, inserting the CBL technique can enable students to solve a wide variety of clinical cases[8,12], allowing them to develop the ability to plan different types of partially edentulous arches with RPD. This repetition of case studies can be conducted in discussions by groups of students using the Brainstorming technique, in which the ideas exposed by the students guide their own knowledge[12].

Therefore, the objective of this study is to present the experience of combining techniques such as CBL, the Inverted Classroom and Brainstorming gradually implemented during practical activities as a strategy to stimulate active learning in the Preclinical Removable Partial Denture Course at the Federal University of Paraíba (UFPB) in Brazil in order to develop the students' skills and competencies. This proposal came from the core of traditional teaching and was aimed at greater student learning, not only regarding the theoretical content itself, but also to increase their critical capacity in their own knowledge construction. In addition, instructional materials designed to encourage

active student participation in the teaching-learning process of this curricular component are presented.

2 EXPERIENCE REPORT

This article is an experience report with a descriptive design, and presents the Removable Partial Denture Course at UFPB as a scenario. It was developed by professors and doctoral students who used active methodology strategies and developed instruments to be applied to undergraduate students, seeking to consolidate and improve learning in pre-clinical teaching.

The RPD course is theoretical-practical, taught in the 7th period of the Dentistry Course with a total of 60 hours. An average of 30 students are enrolled per semester, and divided into three groups to carry out practical activities in the laboratory. Initially, laboratory activities were exclusively for training students' technical skills, such as mouth preparation, determining the insertion path (including building devices to record the path such as plates, and transfer-guide crowns), impression, casting models and techniques for metallic framework design, among others. However, it was observed that although developing technical skills is required for training dental surgeons, it is equally essential that there is an integration of theory with practice. As a consequence, students' competences are developed so that they can carry out the RPD planning of their patients in the following curricular components, the integrated clinics.

Thus, as the first step towards a philosophical change in the pedagogical process, a change was gradually carried out in the teaching model by inserting active methodologies during practical classes for which the students have most of their workload. In addition to training technical skills, students participated in group discussions to consolidate the concepts presented in theoretical classes, essential for planning partially edentulous arches using the strategies described below.

Combining Case-Based Learning (CBL) and Brainstorming

The CBL technique has been relevant in knowledge production and constitutes an effective learning methodology in which different clinical cases are proposed for discussion and development of individualized treatment plans[5,13]. Then for each specific idea or content, students can use the Brainstorming technique to express their ideas without judgment and contribute to construct concepts and problem solving[12,14].

The methodological proposal was initially to modify the pedagogical model used in the pre-clinical laboratory by inserting the CBL technique, using two-dimensional schemes of partially edentulous arches in different hypothetical situations in a combination with Brainstorming strategy. As the contents were presented in the theoretical classes, the students were encouraged to apply these concepts to plan the proposed cases during the laboratory classes using a sequence of questions that worked as a checklist for solving the cases. The answers presented to each one of the questions enable discussing the concepts of biomechanics in RPD regarding the principles of support, retention and stability, and guide the students in defining the metallic structure components considering the particularities of each partially edentulous arch.

The cases used in the course are two-dimensional schemes of partially edentulous arches developed from a file created in the

PowerPoint® program, which enable simulating different Kennedy Classes and selecting the dental elements to be excluded from the complete matrix (figure 1). Thus, the cases are assembled following a degree of complexity, starting with the pure Kennedy Classes and following the concepts discussed in the theoretical classes.

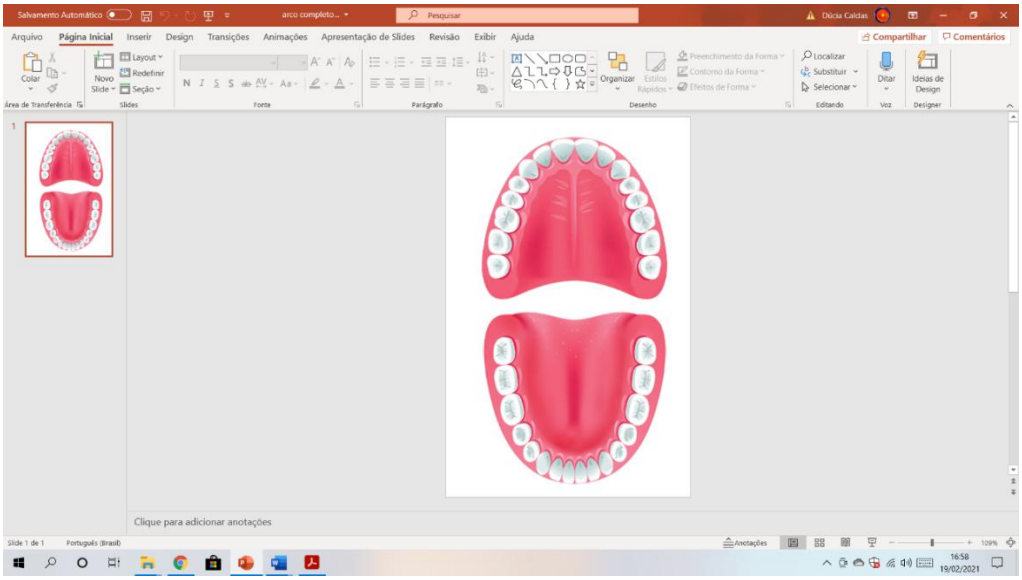

Figure 1. Model for assembling partially edentulous arches

The instructional material prepared (two-dimensional model + checklist of questions) is shown in Figure 2 and consists of a partially edentulous arch, some relevant information simulating data obtained in the clinical examination and/or design (for example, dental inclinations, undercut areas, required aesthetics of the case, periodontal condition of dental support, distance between the floor of the mouth and the gingival margin, among others) and a table containing the sequence of questions that must be completed by the student according to the peculiarities of each arch. Clinical data were suggested and described together with the cases to make the scenario closer to reality, aiming to develop student learning regarding the interrelationship with other areas such as Periodontics, Dentistry, Endodontics and Occlusion, which is highly necessary for planning partially edentulous arches.

Students begin the activities in laboratory classes in pairs, and then they present their planning proposals to the class in an expository and interactive way. During the presentation, listening students are encouraged to ask questions, suggest modifications and clarify doubts in the proposed planning. In the same way, professors simulate different clinical conditions for the case, stimulating critical thinking to indicate different mechanical components. Accordingly, students actively participate in the learning process and teachers act as mediators of the discussions. Encouraging this interaction between presenters and listeners allows important

discussions regarding the factors to be considered for decision making. With this, in addition to training technical skills essential for the stages of making a RPD, the students' competences are developed for planning and selecting the metallic structure components, and constitutes a step which is directly linked to the treatment success (figure 3).

Two-Dimensional Models for Planning RPD

Dental Arch 1

Relevant clinical data: Mesial inclination and retentive area adjacent to the edentulous space in tooth 36. Lingual inclination and retentive area on this face in tooth 47.

1- What is the Kennedy's Classification?
2- What are the Supporting Elements? What is the type of prosthesis?
3- Which are the Main Abutment Teeth?
4- How are the Main Abutment Teeth distributed in the Arch?
5- Is there Rotation? **Where does the Fulcrum Line cross?**
6- What elements are necessary to minimize the Rotation Movement? *
7- Which are the Secondary Abutment Teeth?
8- Where are the Main and Secondary Rest Seats located?
9- Which retainers are indicated for Main and Secondary Abutment Teeth?
10- Which Major Connector is appropriate for this case?

Figure 2. Illustrative model using Case-Based Learning and a Checklist to guide Brainstorming

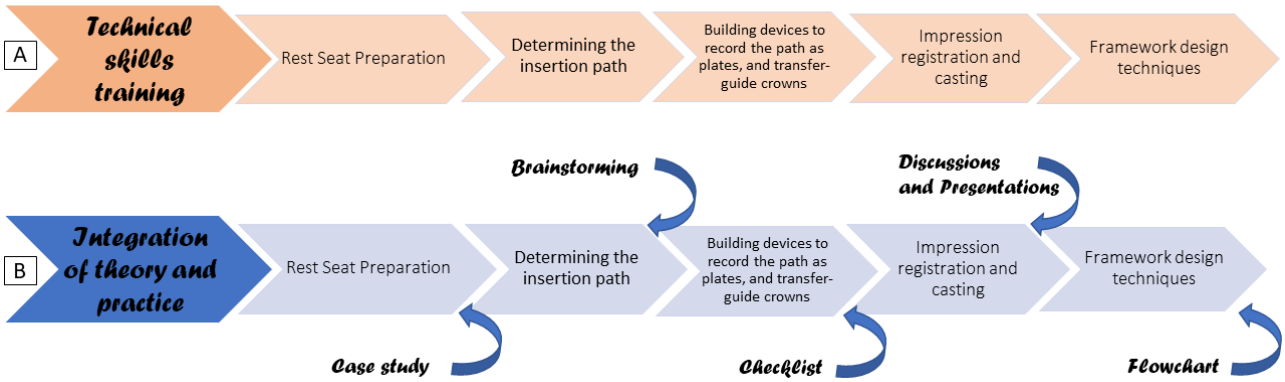

Figure 3. Process of pedagogical change in the practical classes of the Preclinical Removable Partial Denture Course. A. Previous focus only on the students' technical skills. B. Insertion of different learning strategies aiming to develop student skills and competencies

Developing a flowchart to assist in planning and selecting the components

A flowchart was developed from introducing the active methodology in the pre-clinical course to be used as an auxiliary tool in the teaching-learning process.

The flowchart represents the sequence and interaction of activities through graphic symbols[15]. It is a visual map, in which the steps of certain processes and the decisions generated in each stage are pointed out and more easily visualized. In a study by Vilar et al. (2016)[16], the use of a flowchart in teaching periodontics proved to be efficient for decision making regarding the diagnosis of periodontal diseases.

In a different approach, the flowchart was developed as a visual map to guide the student in the RPD planning, presenting some options of mechanical components usually indicated in pure Kennedy Classes. Figure 4 presents the flowchart, in which it is possible to visualize the necessary steps for the planning of a RPD, directing the students' reasoning and helping them to solidify the content. The main steps addressed in elaborating the planning are to identify the support elements of the prosthesis; identify the edentulous areas, enabling the classification according to Kennedy[17]; identify the main abutment teeth; delineate the fulcrum line; identify secondary abutment teeth; locate the main rest seats; indicate direct and indirect extracoronary retainers, as well as a major connector of choice for pure Kennedy Classes (Classes I, II, III and IV).

Presenting some components in the flowchart aims to facilitate memorization of the most widely indicated components. Students should be warned that the data obtained in the clinical examination and during the study of models are essential and decisive to select ideal mechanical components for each arch.

Contextualizing the active methodology and RPD

According to Preti (2002)[18], modern pedagogical practice is mainly influenced by three paths: empiricism, innatism and dialectics. In empiricism, the teaching-learning process is centered on the teacher who defines strategies for the student to assimilate all the content, while the student memorizes, repeats and accumulates isolated information without questioning.

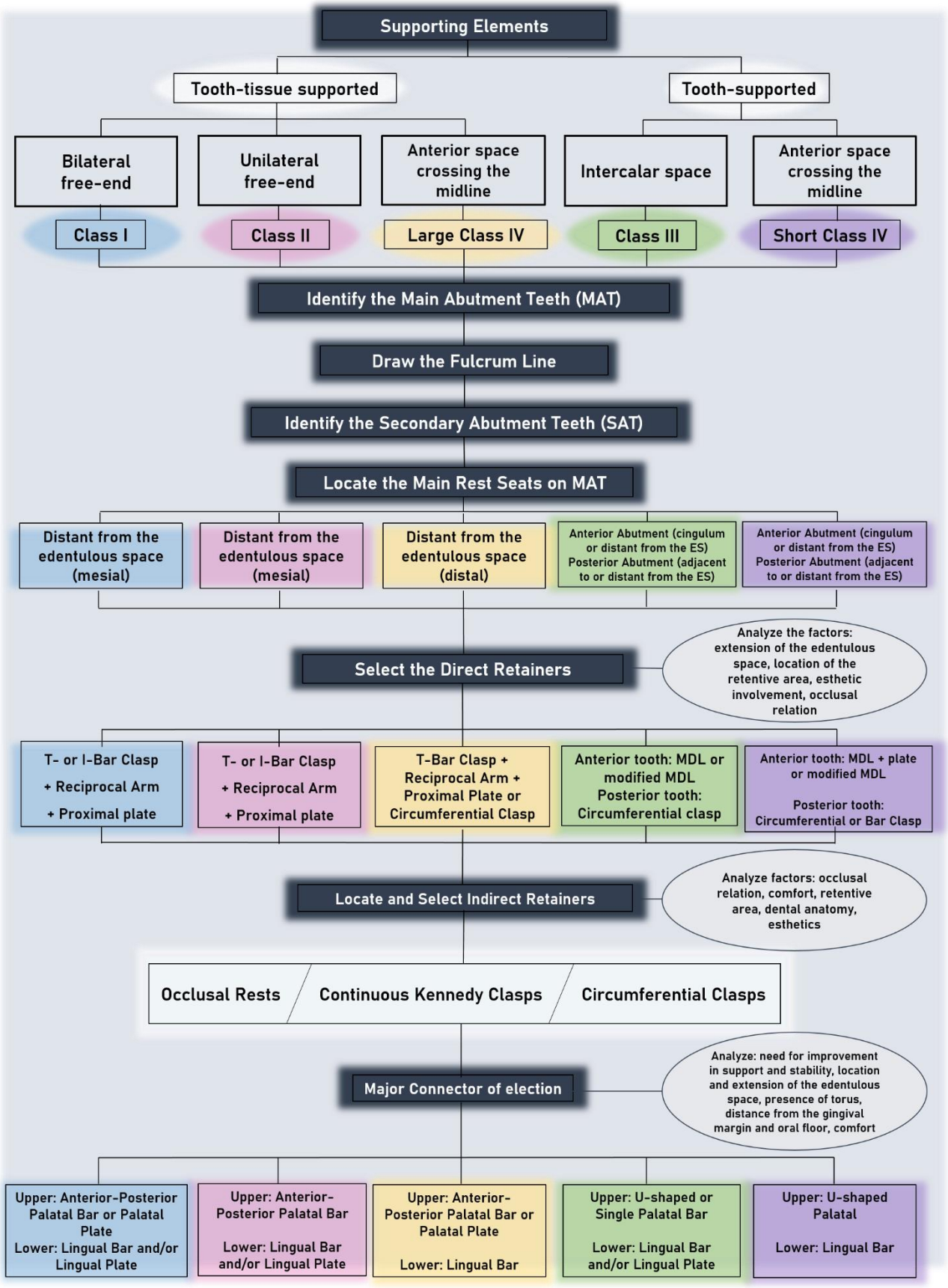

Figure 4. Flowchart for RPD planning

This constitutes a method which more instructs, teaches and trains than forms and educates. The central focus in innatism is the student and knowledge comes from ideas and not from experience, with the institution, school or teacher having the role of creating conditions to awaken this student to search for their learning. In turn, dialectics focuses on the synthesis of the two positions based on the concept that knowledge is not transmitted or acquired, but constructed as a result of exchange and dialogue. The student is the center of the process and the teacher assumes the role of mediator, guiding them throughout the learning process through the creation of challenging pedagogical situations in their traditional way of learning, seeking new forms of organization, assimilation and construction. In this context, the faculty of the discipline proposed a change in teaching RPD through implementing methodologies which brought the student to the center of the teaching-learning process, making them an active part in their learning construction, as an alternative to the model of merely traditional teaching still historically present in most universities. This is a gradual process through inserting active methodologies during the moments of practical activities which constitutes a large part of the students' workload.

These methodological changes in higher education have been widely stimulated by the National Curriculum Guidelines, aiming at active student participation and making them responsible for building their own learning[19]. Some studies have already addressed active methodologies in teaching pre-clinical RPD[8-10], but there is a need for greater dissemination of ideas and materials used to help teachers to find new approaches to teaching this curricular component. Thus, the combination of techniques adapted from CBL, Inverted Classroom and Brainstorming emerge as a promising tool to stimulate critical thinking, functioning as training for clinical decision making in RPD.

Many dentists face a great problem in clinical practice to adequately plan RPD cases, transferring the responsibility of selecting mechanical components to the dental technician. Torban et al. (2016)[20] showed that 84.5% of the models sent to the laboratory did not present planning and 7.2% of the plans were incorrect, in addition to 80.3% which did not present mouth preparation. However, it is possible to modify this reality using teaching methodologies that encourage the student to practice planning from the pre-clinical stage, and make them able to individually plan and design metallic framework in detail for each patient, which are factors that directly influence RPD success[21].

Reformulating dental education using methods that integrate theoretical knowledge with practical training showed positive results with a greater resolution of clinical cases in both the diagnosis and in the treatment plan, as well as improvement in professional-patient communication[22]. One of the strategies which can be used is the CBL, a tool that uses correspondence with clinical cases to improve the learning, stimulating participation in an efficient way and also reconciling theoretical and practical study[5].

Some studies have compared the CBL with traditional teaching methodologies, such as Alhazmi and Quadri (2020)[13], who carried out a randomized clinical trial with dental students and observed greater effectiveness and satisfaction of undergraduates in relation to the diagnosis in Orthodontics, and suggested incorporate this methodology in the curriculum of education institutions.

Practical activities in Dentistry, especially in Prosthodontics, are extremely important for the development of students' skills[10], and the adopted teaching strategies must combine

traditional methods and active methodologies in order to improve learning, which has been done in our course. Godderidge et al. (2019)[7] carried out a retrospective study of the curriculum transition from the traditional methodology to an active methodology in teaching Fixed Prosthodontics, replacing traditional classes with learning groups using student-oriented cases, and as a result, they obtained an increase in learning efficiency and a reduced load in the classroom, reassuring the importance of the active methodology.

The use of CBL in RPD teaching was compared with the traditional methodology and a preference of the students and greater confidence in elaborating the treatment plan when using the active methodology was observed. The authors suggest this teaching strategy in preclinical practice[8]. CBL worked as an ideal tool in our course by enabling different plans to be implemented, improving the students' ability to develop a treatment plan for future clinical cases, and put the theoretical knowledge into practice through association with the Brainstorming technique. The pedagogical strategies adopted in the discipline enabled developing competencies, as they contributed to improve knowledge, skills and attitudes. The stimulus to seeking knowledge and consolidating learning using the instructional materials offered by the course and the techniques described in CBL and Braisnstorming, for example, stimulated the student in their learning construction. In the same way, the skills were acquired at the moment when the student performed the training regarding the planning in partially edentulous arch schemes, training their decision-making for the dental clinic and improving themselves for patient care. Attitudes were also worked on, which are the student's personal attributes, characteristics or qualities such as self-confidence in the content, the ability to communicate with colleagues, the possibility of developing logical reasoning for clinical decision-making, and relate to the group in the moments of discussions in the Inverted Classroom model.

Combining active methodologies in the learning process provided positive results in the subjective evaluation of the students and especially of the Pre-Clinical RPD professors, who observed greater interest, participation and interactivity. However, this is an experience report of a new approach, and it was not possible to verify the impact of this new strategy on learning, which is one of the limitations of this study. Likewise, only implementing active methodologies in the moments of practical classes can also be cited as a limitation, although it was possible to direct the student in planning precisely because of this connection between theory and practice. Even with all the challenges and limitations inherent to the course, it was possible to observe the development of these students during the restricted moments of laboratory activities. We intend to continue this approach by also diversifying methodologies and implementing the new teaching philosophy in theoretical classes, so that the philosophical change of this pedagogical process is gradually accepted by other Prosthodontic disciplines.

Although real clinical cases were not used in the CBL, it is understood that providing the student partially edentulous arches and hypothetical clinical information can guide them in decision making. As a consequence, this considerably helps them in their learning construction and to develop their competencies, since many students come to clinics without even having performed RPD planning. The RPD course at UFPB is pre-clinical, and involves the student in planning partially edentulous arches when they could only be training their technical skills (manual), but it is essential to prepare them

for clinical care in the following curricular components, the Integrated Clinics. This strategy was adopted by the RPD course without being directed to a change in the institution's teaching philosophy. However, it is a long-term objective to consolidate this philosophy with integration into the three disciplines of Prosthodontics.

Considering the difficulty in establishing the use of active methodologies applied to RPD, it is important to disseminate didactic materials and developed methodologies which stimulate the teaching-learning process centered on the student. Thus, it is necessary to carry out future studies to qualitatively and quantitatively evaluate the changes that the application of these materials and methods can generate in the learning process of undergraduates in the Dentistry course at UFPB.

3 FINAL CONSIDERATIONS

Teaching preclinical Removable Partial Dentures through directly applying knowledge in the clinical routine and the constant stimulation of critical thinking during planning seems to be an effective approach to long-term learning. The adaptation of teaching strategies with the active participation of students can be a useful tool in verifying difficulties during planning and that can be solved prior to patient care in dental clinics.

The instructional materials developed in this course can help Dentistry professors to think about different methodologies in teaching RPD and insert the students in the process of building their knowledge.

RESUMO

Combinando estratégias de aprendizagem para o desenvolvimento de habilidades e competências na Prótese Parcial Removível pré-clínica: um relato de experiência

O uso da metodologia ativa no ensino da Odontologia é recomendado nas Diretrizes Curriculares Nacionais, com a finalidade de desenvolver habilidades e competências, assim como de estimular a capacidade reflexiva dos egressos. Em Prótese Parcial Removível (PPR), alguns estudos apontam os benefícios do método centrado no aluno, utilizando diferentes estratégias, como *Problem-Based Learning* (PBL), *Case-Based Learning* (CBL) e *Team-Based Learning* (TBL) com resultados positivos no processo ensino-aprendizagem. Este artigo tem como objetivo relatar a experiência do uso de metodologias ativas como o CBL, a Sala de Aula Invertida e a estratégia do *Brainstorming* na disciplina de Prótese Parcial Removível da Universidade Federal da Paraíba, estimulando o desenvolvimento do pensamento crítico do aluno no planejamento de arcos parcialmente desdentados desde a fase pré-clínica. Como produto dessa mudança na estratégia pedagógica, desenvolveram-se materiais instrucionais como um *checklist* de perguntas e um fluxograma que foram implementados como ferramentas facilitadoras no processo ensino-aprendizagem durante as práticas de laboratório. A adaptação de estratégias de ensino com participação ativa dos estudantes pode ser útil na verificação das dificuldades durante o planejamento, as quais podem ser solucionadas previamente aos atendimentos de pacientes nas clínicas. Os materiais instrucionais desenvolvidos na disciplina podem auxiliar os professores de Odontologia a refletir sobre diferentes formas de metodologias no ensino da PPR e inserir o aluno no processo de construção do seu conhecimento.

Descritores: Educação em Odontologia. Prótese Parcial Removível. Aprendizagem.

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