**Peer Instruction in learning to mount a semi-adjustable articulator**

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**ABSTRACT**

The active teaching-learning methodologies are challenging to both the professor and student, and to teaching institutions. The aim of the present study was to diagnose the conditions most favorable to learning, by comparing different methods of teaching third semester students about mounting a Semi-Adjustable Articulator, at the São José Dental School, Rio de Janeiro, Brazil. The participants in this study were 140 students, divided into two groups, Group I: Reading the article, and a lecture demonstration, and Group II: Peer Instruction(PI). The following aspects were evaluated: the level of participation in the proposed activities, the way in which knowledge was constructed, the number of errors and correct outcomes obtained in the practical activities, in addition to command of the subject approached and the student’s professional posture. In Group I, 6 (21.4%) students were observed to perform correct mounting of the models, and in Group II, 26 (29.2%) presented this result. The most prevalent errors occurred in the stages of compensation with wax (Group I: 18 - 35.3%; Group II: 26 - 29.2%) intermaxillary register (12 - 23.5% in Group I; 17 - 19.1% in Group II). The result obtained proved that the PI teaching proposal used in Group II favored learning, because there was an increase in the number of correct outcomes obtained in the activities, and command of the concepts that involved the handling and operation of the equipment used.

## Descriptors: Higher Education. Dental Occlusion Active Learning.

**1 INTRODUCTION**

Teaching Dentistry in Brazil has undergone diverse changes, among them the continuous introduction of new teaching technologies determining that new scientific researches about their efficacy should be conducted. These information and communication technologies inserted in the field of education have provided new debates about knowledge1.

The acquisition of dexterity, knowledge, affective processes and professional values define the practical competence in Dentistry, therefore the regulation and evaluation of the methods of learning have become essential components of education, useful for both improvement in the quality of teaching and for the quality of alumni2,3.

For the education of health professionals, some studies have pointed out that the traditional model (classical or Cartesian) that has been used for decades was insufficient in the face of the new reality. Do not consider the particularities of the Brazilian national health system (SUS) and ignore the inadequacy of professionals prepared to deal with the demands of Brazilian reality, because they need to have continued education to reach a critical-reflective profile and have the capacity for developing work in groups5,6.

The active methodologies (AM) are educational concepts that stimulate teaching-learning critical-reflective processes, in which those being educated participate and commit themselves to their learning, favoring satisfactory performance and reflection of the students about the problems. The AM make resources available for researching problems and solutions; they identify and organize the hypothetical solutions most adequate suited to the situation and the application of solutions4.

The dissatisfaction of university students with the educational practices, and especially with the distancing between theory and practice is evident in exercising the profession7. According to some researches, this aspect is frequently pointed out as the main factor for dropouts from undergraduate courses in Dentistry8-11 and determinant in professional choices12-16.

With the purpose of reducing the number of dropouts, and attenuate the degree of dissatisfaction experienced by students, the Mas may help with the cognitive development of students in view of the challenges of the chosen profession. From this perspective, Peer Instruction, or instruction by colleagues (IbC) is an active learning method that may support the difficult task of elucidating theoretical languages, making them appropriate for the everyday demands of the profession. The method was outstanding because it used an approach whereby the students were willing protagonists of learning, so that the knowledge provided the learners with skills and competences that helped them to solve everyday problems17-20.

The AMs are based on autonomy, a theoretical principle that was explicit in the invocation of Paulo Freire21. From this aspect of logic, learning must involve the active participation of students by means of writing, reading, discussing, resolving problems, and constructing a synthesis and analysis. Therefore, this methodology has been used in different areas of knowledge22-25.

The aim of the present study was to evaluate the AM PI in the discipline of occlusion, of the Dental School of Faculdades São José, Rio de Janeiro, Brazil, and compare it with the traditional approach (lecture demonstration, previous reading and discussion of the article on the subject).

**2 METHODOS**

The research was approved by the Ethics Committee on Institutional Research (CAAE 55725416. 0.0000.5259). An observational study was developed in the period of a school year. One hundred and forty (140) students participated in the study, and were randomly divided into two groups: Group I (n=51), previous reading of the article about the proposed topic and a lecture demonstration with discussion; Group II (n=89), PI method. The following aspects were evaluated: the level of participation in the proposed activities, the way in which knowledge was constructed, the number of correct outcomes obtained in the practical activities, in addition to command of the subject approached and the student’s professional posture.

In the first stage - that of concepts - the students of Group I received and article about the main steps in mounting a diagnostic cast in an articulator. These concepts were approached by way of reading and debating in the classroom, where the doubts were raised and questions answered about the article, in the form of a test.

In Group II, the PI method group, the students also received the same article, in addition a test was sent by e-mail to prove that the article had been read. Doubts were discussed in the classroom, when the professor made an initial exposition of a concept or content, for no longer than 20 minutes. After this, a conceptual multiple choice test was presented, to be individually responded by the students (approximately two minutes)17. The professor was informed of the responses by means of colored flashcards corresponding to the color of the alternative chosen.

If the frequency of correct answers were in the range between 30% and 70% the students were instructed to form small groups, preferably with colleagues who opted for different (color) alternatives in the conceptual test, and discuss the issue for about three minutes, when they voted again. The purpose was that they would individually reflect and afterwards discuss their responses in groups, before knowing which the correct answer was.

According to the responses and number of correct answers the professor would proceed with the explanation, or followed-up with a discussion in pairs, and after the discussion, ask the questions again. If the number of correct answers were higher than 70%, they would go on to the next item. If there were a significant percentage of errors, and the number of right answers were lower than 30%, the lesson was interrupted and the students had to review their concepts20.

**3 RESULTS**

For the majority of the students (132 - 94.3%) this was the first contact with the procedure proposed, the remainder had previously done technical courses in the area, such as dental prosthesis technician, in oral health, or had experience in dental clinics or offices.

Of the participants in the study, 105 (75%) were women, and 35 (25%) were men. In Table 1,the errors are described per stage and group, and also by gender. In Group I, 6 (21.4%) students were observed to perform correct mounting of the models, and in Group II, 26 (29.2%) presented this result. The most prevalent errors in the groups occurred in the stage of compensation of wax (Group I 18 - 35.3% and Group II 26 - 29.2%), in intermaxillary register (12 - 23.5% in Group I and 17 - 19.1% in Group II). It must be emphasized that in spite of the number of correct outcomes in Group II having been higher than those in Group I 14 (27.5%) of Group I and 14 (15.7%) of Group II did not conclude the activities proposed because they did not hand in the final report of activities.

**4 DISCUSSION**

The present study evaluated the effect of the active method PI compared with the reading and discussion of the article about the topic, on the performance of third semester undergraduate Dental students in the application of theoretical concepts about mounting study models in an ASA; and in the application of concepts of occlusion in the mounted models.

As regards the difference in performance between the genders, the proportion of correct mounting in Group I was 25% for men and 5.7% for women; and in Group II, 36.8% for men and 27.1% for women. It was possible to observe that although the literature was not consistent with regard to the difference in gender when exploring the themes proposed3, in both genders there was an increase in the percentage of correct outcomes and the aims of the discipline were achieved in Group II.

Table 1 Errors committed by the studied groups, per stage of activity and per gender

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Group** | **Gender** | **Errors in Mounting (number of students)** | | | | | **Mounting**  **Correct**  **n (%)** | **Without**  **Report**  **n (%)** |
| **Facial Arch**  **n (%)** | **Maxillary Model**  **n (%)** | **Intermaxillary Register**  **n (%)** | **Compensation Wax**  **n (%)** | **Mandibular Model**  **n (%)** |
| I | Fem | 0 - 0 | 0 - 0 | 9 - 17.6 | 14 - 27.5 | 1 - 2 | 2 - 3.9 | 9 - 17.6 |
| Male | 0 - 0 | 0 - 0 | 3 - 5.9 | 4 - 7.8 | 0 - 0 | 4 - 7.8 | 5 - 9.8 |
| Total | 51 | 0 - 0 | 0 - 0 | 12 - 23.5 | 18 - 35.3 | 1 - 2 | 6 - 11.8 | 14 - 27.5 |
| II | Fem | 2 - 2.2 | 1 - 1.1 | 15 - 16.9 | 21 - 23.6 | 1 - 1.1 | 19 - 21.3 | 11 - 12.4 |
| Male | 1 - 1.1 | 0 - 0 | 2 - 2.2 | 5 - 5.6 | 1 - 1.1 | 7 - 7.9 | 3 - 3.4 |
| Total | 89 | 3 - 3.4 | 1 - 1.1 | 17 - 19.1 | 26 - 29.2 | 2 - 2.2 | 26 - 29.2 | 14 - 15.7 |

Prado *et al.*5 warned that the traditional model does not consider the needs of SUS and educates professionals who are unprepared to deal with their reality, who have not acquired a critical-reflective profile and were incapable of developing work in groups.With the purpose of providing more humanized attendance to the population and application of professional activity based on evidence, the authors expect that the teaching-learning process may form active and independent professionals, leading to overcoming the distance between theory and practice, placing value on articulated work between the health service and community22.

In this context participation of the students was an important aspect. The results revealed that 14 student in each group did not conclude the activities proposed, because they did not hand in the final report on activities. The percentages of students without report was lower (27.5%) in Group I, characterizing greater participation in Group II, however, it was clear that this aspect still needs more attention, demonstrating that in spite of PI increasing participation in the classroom and in practical activities, it is still necessary to attribute grades for handing in written activities.

The AM are a challenge to educators, seeing that to make use of them, it is not only necessary to know the modes of operationalization, but also the principles of critical pedagogy, which delegates the role of mediator to the professor in the teaching-learning process. Thus AMs have the function of leading students to observing reality and apprehending the content they extract from the themes presented4-6.

Sobral and Campos4 (2012) emphasized that it was necessary to be aware that the AMs are not a mere set of tools directed towards professional education or for educational actions in the health services. This methodology demands a pedagogical activity based on well-defined objectives, considering its main characteristics: the subjects participate actively in the teaching-learning process, seek knowledge and appropriate knowledge, reflect critically about that which they learned so that afterwards they perform actions and transform the reality in which they live.

Crouch *et al.*19 affirmed that it was fundamental for the success of the PI method to choose conceptual tests with adequate levels of difficulty. The questions selected, according to the difficulty of the students, must approach a single relevant concept. Moreover, they must not test memory.

In addition to the number of correct outcomes in the activities proposed in the disciple, the greater quest by students, who had already obtained a pass grade in the discipline, for projects of initiation in research and monitoring was notable; in addition they sought projects associated with the discipline, such as the Academic League of Temporomandibular Dysfunction in partnership with the Physical Therapy Course at the São José Faculties. However, excessive concern about evaluation is still notable among the students, instead of them placing value on the acquisition of knowledge and mastery of the technique3. In this sense, it is necessary to use methodologies that perceive professional practice in view of the reality of persons who use the health service, and not only disciplines that are characterized by an exaggerated and voluminous content to be memorized and later forgotten24.

The demand for maturity and professional posture suited to the reality was confirmed in the observations of Super12, who used maturity to evaluate the stage of development of the career achieved by students of different ages and educational levels compared with the aptness for decision making. The skills, competences and attitudes of coping may not vary with age, considering the adaptability of the career, indicating balance between the world of work and personal space, in addition to the ability to seek and accept changes in roles of the career over the course of time12,13.

The dimensions of maturity proposed by Super12,13 would be: a) capacity for planning, being also related to self-esteem; b) capacity for exploration; c) information about the world of work and the options offered; d) taking decisions, ability resulting from evaluation of the possibilities; and e) orientation to reality.

The set of these characteristics compose the readiness for making a decision or a condition of the individual for the necessary change of behavior in response to the demands pointed out by various studies7-15. The contribution of AMs to stimulating development of this behavior was clear.

In spite of the increase in the number of correct outcomes in the activities, a concentration of errors still remained in the stages of intermaxillary registration and compensation of wax. These results suggested the need for specific didactic material for the understanding and reproduction of intermaxillary relations, directed towards students in transition from the theoretical cycle to the practical cycle; and implementation of teaching directed towards self-learning and a quest for autonomy of knowledge for the resolution of concrete problems encountered in daily activities.

Therefore, the use of AMs demands certain resources, delegating to the Higher Education Institutions the task of preparing the instruments necessary for their application and together with the professors and students, promote a culture of responsibility; that is, involve the academic community in the principles of the methodology. Thus, students and professors have to be made aware of the responsibility of teaching the theoretical content and cultivating in students the development of reflection based on the results of scientific researches3.

**5 CONCLUSION**

The PI method of teaching applied in the discipline of occlusion favored greater appropriation of the theoretical contents worked on in the classroom, because there was a significant increase in the number of correct outcomes of the technical procedures evaluated, showing evidence of greater command of the concepts that involve the handling and operation of equipment used in the discipline.

## RESUMO

## Peer Instruction no aprendizado da monta-gem de articulador semiajustável

As metodologias ativas de ensino-aprendizagem são um desafio tanto para o docente quanto para o discente e instituições de ensino. O presente estudo objetivou diagnosticar as condições mais favoráveis ao aprendizado, comparando diferentes métodos de ensino sobre montagem de articulador semiajustável (ASA) para estudantes de terceiro período da Faculdade de Odontologia São José, Rio de Janeiro, Brasil. Participaram deste estudo 140 estudantes divididos em dois grupos, Grupo I: Leitura de artigo e aula expositiva e Grupo II: *Peer Instruction* (PI). Foram avaliados o nível de participação nas atividades propostas, a forma como o conhecimento era construído, o número de erros e acertos obtidos nas atividades práticas, além do domínio do assunto abordado e a postura profissional do aluno. Observou-se que no Grupo I 6 (21,4%) estudantes realizaram correta montagem dos modelos e no Grupo II 26 (29,2%) apresentaram este resultado. Os erros mais prevalentes ocorreram nas fases compensação de cera (Grupo I: 18 - 35,3%; Grupo II: 26 - 29,2%) e registro intermaxilar (12 - 23,5% no Grupo I; 17 - 19,1% no Grupo II). O resultado obtido comprovou que a proposta de ensino PI, empregada no Grupo II, favoreceu o aprendizado, uma vez que houve aumento do número de acertos nas atividades e domínio dos conceitos que envolvem o manuseio e a operação dos equipamentos utilizados.

## Descritores: Educação Superior. Oclusão Dentária. Aprendizagem Ativa.

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