

Peer Instruction as an active strategy of learning in Dentistry


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Abstract The Peer Instruction methodology was proposed to transform the pedagogical practices of Harvard's physics program. Even though it was developed in 1991, this method has not been very reported in literature focusing on health science. So, this study aims to report and discuss the perception of dentistry students and professors from the University (blinded for peer review), that has been using the Peer Instruction methodology. The strategy consists of small debated exhibitions followed by a question. The students must answer the multiple-choice question individually. After, they have to convince their classmates why their answer is the right one, presenting arguments and debating them. After Peer Instruction, there is a poll. When less than 30% of students answered correctly, the topic was explained again. Between 30 and 70%, the topic was debated again, with the group. When more than 70% of students answered correctly, the topic was closed. From the students' reports, it was possible to see that the Peer Instruction methodology can be used as an active teaching and learning tool in dentistry programs. The method seems to favor mainly attention, debate, and understanding of concepts. However, the ability to solve problems seems to be less facilitated with the methodology. Peer Instruction can be an interesting strategy for professors who seek to transform their expository classes into active approaches.

Descriptors: Education, Dental. Teaching, Methods. Students, Dental.

Instrucción entre Pares como estrategia de aprendizaje activo en odontología Resumen

La metodología de Instrucción entre Pares se propuso para transformar las prácticas pedagógicas del programa de Física de Harvard. A pesar de haber sido desarrollada en 1991, este método es poco conocido en la literatura especializada en ciencias de la salud. Por lo tanto, este estudio busca reportar y discutir la percepción de estudiantes y profesores de odontología de una universidad (ciega a la revisión por pares) que ha estado utilizando la metodología de Instrucción entre Pares. La estrategia consiste en presentaciones breves y debatidas, seguidas de una pregunta. Los estudiantes deben responder individualmente a la pregunta de opción múltiple y luego deben convencer a sus compañeros de por qué su respuesta es correcta, presentando argumentos y debatiéndolos. Después de la instrucción entre pares, se realiza una encuesta. Cuando menos del 30% de los estudiantes aciertan, se vuelve a explicar el tema. Entre el 30% y el 70%, se vuelve a debatir el tema con el grupo. Cuando más del 70% de los estudiantes aciertan, se concluye brevemente el tema. Según los informes de los estudiantes, se observó que la metodología de instrucción entre pares puede utilizarse como una herramienta activa de enseñanza y aprendizaje en los cursos de odontología. El método parece favorecer principalmente la atención, el debate y la comprensión de conceptos. Sin embargo, la capacidad para resolver problemas parece verse menos facilitada con esta metodología. La instrucción entre pares puede ser una estrategia interesante para los docentes que buscan transformar sus clases expositivas en enfoques activos.

Descriptores: Educación en Odontología. Métodos de Enseñanza. Estudiantes de Odontología.

Peer Instruction como estratégia ativa de aprendizagem em Odontologia Resumo

A metodologia *Peer Instruction* foi proposta para transformar as práticas pedagógicas do programa de física de Harvard. Apesar de ter sido desenvolvido em 1991, esse

método é pouco divulgado na literatura voltada para as ciências da saúde. Assim, este estudo tem como objetivo relatar e discutir a percepção de estudantes e professores de odontologia de uma universidade (cega para revisão por pares), que vem utilizando a metodologia *Peer Instruction*. A estratégia consiste em pequenas exposições debatidas seguidas de uma pergunta. Os alunos devem responder individualmente à questão de múltipla escolha, depois devem convencer os colegas porque sua resposta é a correta, apresentando argumentos e debatendo-os. Após a "Instrução por Pares", há uma enquete. Quando menos de 30% dos alunos acertaram, o tema é explicado novamente. Entre 30 e 70%, o tema volta a ser debatido, com o grupo. Quando mais de 70% dos alunos acertaram, o tópico é finalizado brevemente. A partir dos relatos dos alunos foi possível perceber que a metodologia *Peer Instruction* pode ser utilizada como ferramenta ativa de ensino e aprendizagem nos cursos de odontologia. O método parece favorecer principalmente a atenção, o debate e a compreensão dos conceitos. Porém, a capacidade de resolução de problemas parece ser menos facilitada com a metodologia. A *Peer instruction* pode ser uma estratégia interessante para professores que buscam transformar suas aulas expositivas em abordagens ativas.

Descritores: Educação em Odontologia. Métodos de Ensino. Estudantes de Odontologia.

INTRODUCTION

Teaching based on the transmission of knowledge from a slide presentation, as being focused only on the specific skills of the professor in the theoretical explanation, has become inefficient in promoting the development of student's skills and competencies¹⁻⁴. The National Curriculum Guidelines for Dentistry have directed educational institutions to promote environments that allow the development of activities that not only aim at the specific knowledge understanding, but also promote the strategies to solve real problem situations that require specific knowledge, develop skills such as leadership, communication, and teamwork^{5,6}. In this context, only the cognitive domain of the different areas of knowledge is not enough to achieve the objectives of developing different skills, because they are complex and cannot be achieved without the active participation of the students^{7,8}.

Many teaching and learning methodologies have been developed and incorporated into different graduate courses to actively develop skills and competencies^{2,9-13}. The methodology called Peer Instruction was proposed by Erik Mazur in 1991, at Harvard University, aiming to improve the pedagogical practices that are often seen as distant from professional reality^{10,14}. Initially, Mazur (physics professor) developed Peer Instruction to be used in introductory physics learning. Currently, several disciplines¹⁵ have appropriated the technique and transposed it to others¹⁶⁻²⁰, such as the basic sciences and genetic disciplines¹⁶. On the other hand, this technique has been little mentioned in the literature with a focus on Dentistry courses.

Recent studies suggested that Peer Instruction is effective mainly in promoting students' conceptual understanding, facilitating concentration, increasing the dynamics of pedagogical activities, as well as providing better retention of the worked knowledge^{10,14,21}. In this way, the technique is based on the conceptual presentation of specific topics, which are followed by problem situations or technical questions to be answered by the students. These questions must be structured to require the practical or conceptual application of the knowledge previously discussed. Mazur (add year)¹⁰ during the development of peer instruction, observed that his students were able to answer physics calculations (mechanically) even without having understood the theoretical foundations for solving calculus problems. In short, his students applied the formulas and got calculus questions right, but they didn't have the conceptual knowledge of the problem, which made him change the preparation of his classes and formulate the Peer instruction^{10,14}.

Mazur still noted that it could more easily keep students attentive and focused, as well as encourage discussions when students' responses are contrasting, and encourage a process of cooperation among students^{10,14,15}. Furthermore, the method provides instant feedback on developed cognitive skills, and knowledge gaps can be quickly identified, which can be remedied at the moment¹⁰. Considering the low evidence available in Health Sciences related to this teaching strategy, reports of experiences of Professors and students regarding their perceptions of the pedagogical processes seem to be necessary for the sharing of successful or unsuccessful experiences. The present study aimed to report and discuss the perceptions of the students and professors in the Dentistry course at the University of Vale do Taquari, who have used the Peer Instruction teaching strategy, which is guided by a pedagogical philosophy of active learning as one of the instruments for the development of students' skills and competences.

METHODS

The present study was approved by the ethical committee of Federal University of Pelotas (CAAE 78099824.1.0000.5318).

The Dentistry course, located in Southern Brazil, is a course with an integrated modular curriculum that has been proposed to work with teaching strategies guided by active methodologies²². Similarly, all evaluation processes – which occur in the three dimensions⁸: cognitive, affective, and psychomotor – are carried out in a competency-based approach. During the modules, several teaching strategies guided by active methodologies have been developed: Problem-Based Learning (PBL),²³ Challenge Based Learning (CBL), Peer Instruction, and Flipped Classroom²², among others. The teaching strategy used and described in this paper was used with professors and students of the seventh module, in the discussion of topics related to the dental prosthesis.

The main objectives of Peer Instruction are seen as a better time in the classroom; motivating and keeping students closer; and maintaining team spirit in the construction of knowledge through collaborative work among students. In addition, better knowledge seems to be related to the use of the technique^{10,14,15}.

The technique

According to Mazur¹⁰, the basic objective of the Peer teaching strategy is to explore the interaction between students during classes by focusing students' attention on the concepts that serve as a foundation. He recommends that each topic has a minimum of 15 minutes. Between 7 and 10 minutes of exposure and between 5 and 8 minutes for the conventional test. However, small modifications can be made and adapted to the pedagogical objectives that are intended to be achieved. For example, as one of the main general competencies for Dentistry courses described in the National Curricular Guidelines and targeted by the course is communication⁶, thus, we extended the discussion time proposed by Mazur¹⁰.

In the activities developed by our professor's group, the dialogic exposition was organized to have about 15 minutes of exposition/dialogue and later 10 minutes for the conceptual test and discussion, which often extended to 15 minutes when the discussions were expanded by the students.

It is recommended that conceptual tests focus only on a single concept, do not depend on equations for their solutions, present multiple-choice answers, and that the questions are neither too easy nor too difficult to the point of demotivating the students^{10,15}.

In this way, we could divide the steps of the technique as follows:

- a) Dialogued exposition of the topic (15 minutes);
- b) Presentation of the question and individual student response (students write down their answer) (3 minutes);
- c) Students discuss the issues (Peer Instruction) and try to convince their fellows (7 to 12 min);
- d) Students write down the answer again after discussion;
- e) Survey of responses: advance or resume concepts;
- f) Professors Feedback (topic closing).

Although the technique describes the class in a more expository way, we chose to carry out a dialogic exposition, encouraging – whenever possible – student participation and, consequently, discussion. In this way, the various dialogued expositions had a greater amplitude of time, being less rigid in this aspect. In the present experience report, the exhibitions were carried out through multimedia projection and videos prepared by the professor's group, which served as auxiliary resources for the dialogue.

After each dialogic presentation, a conceptual question was presented to the students who were instructed to answer the multiple-choice question individually and to write down their answers. Sufficient time must be given at this stage for students to read, reflect quickly, and answer the question. After that, the students were instructed to discuss their answers in pairs (peer instruction). In classes with a few students, it is interesting that they discuss in pairs. In classes with large numbers of students, a possible alternative is for students to divide into small groups to discuss the questions. These alternatives favor discussion since the probability of conflicting answers in small groups is greater than in pairs. Thus, students must at this stage convince their colleagues that their answer is the correct one: presenting arguments and discussing them. Mazur¹⁰ reports in his book that about 19% of students switched from wrong to correct answers after paired discussion and only 3% switched from correct to incorrect^{10,14,16}. Emphasizing the value of discussions for

the development of cognitive issues as well as for communication competence. During the process, Professors can be attentive to the discussions, observe possible confusion of the students, and eventually, help them. It is important to emphasize that the Professors' interventions at this stage should be sporadic and punctual, and the students should be the protagonists of the discussion. In addition, it may be interesting to wait to collectively return to these points of confusion after the survey.

After Peer Instruction, a vote must be carried out. There are several approaches reported in the literature for carrying out this survey. There are several approaches reported in the literature. The simplest ones range from making small posters with the letters of the answers to the use of electronic devices^{16,24}. Our professor group performs this process in different ways. It is important to point out that both strategies achieve their fundamental objective. The advantage of using electronic devices is that responses can be performed anonymously, having a general estimate of the student group. This alternative can favor greater engagement among students who do not like exposing themselves to activities. On the other hand, if the objective is for students to expose themselves during the process, the use of boards fulfills this role better. In the present report, we chose to use digital polls through websites that present this possibility (<http://www.kahoot.com>). In this way, the survey responses were presented collectively to all students. However, a version with individual responses can be generated after the activity is over and professors can identify students with greater difficulties and offer other learning alternatives for them.

After the poll, the percentages of correct answers among the students are observed. When less than 30% of the students got the question right, it was detailed and discussed again, always encouraging students who got it right to explain it to the other colleagues, with compliments from the Professors. In addition, a resumption of the dialogued exhibition was carried out in a more detailed and calmer way than the first time. Subsequently, a new conceptual question was presented. When between 30% and 70% of the students got it right, a new Peer Instruction was conducted collectively. Similarly, the importance of students presenting the solutions to other colleagues is emphasized. When necessary, the professor can contribute. In addition, the closing of the topic is an important factor that must be led by the professor.

When more than 70% of the students get it right, the topic is close to winding up. If prudent, students who got it right can give a brief explanation. Any doubts observed by the Professors during the Peer Instruction can be taken up at this stage. Thus, with 70% or more of the questions correct, a new topic can be introduced. A detailed description in flowchart format can be seen in Figure 1.

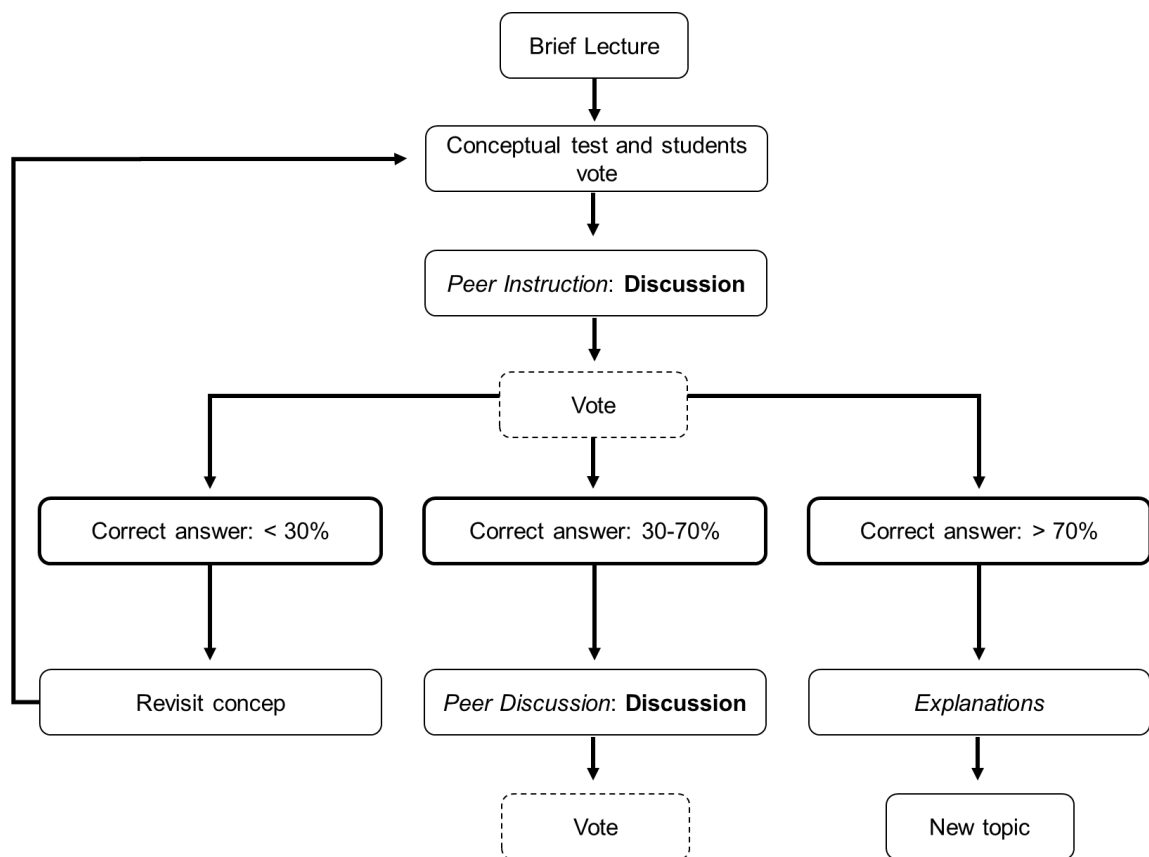


Figure 1. Representative diagram of the teaching strategy guided by active methodologies Peer Instruction.

Evaluation process

In the course of teaching activities, several evaluation processes regarding the methodologies and teaching/learning activities were carried out with the students. These activities aim at a critical and reflective evaluation of the adopted pedagogical practices. In this way, assessments help the redirection of activities and consolidate the training process in the construction of knowledge, which occurs collaboratively between professors and students.

At this stage, forms made by Google Docs (Google Corp., add city, state, country) are often used by the Professors responsible for the activities in that module. Thus, students present their perceptions related to teaching and learning strategies anonymously and with instantaneous feedback, facilitating changes in the techniques addressed and maintaining the positive points pointed out by students. This evaluation form was built with open questions – to reflexively analyze the students' discourse – others being multiple-choice, and on a Likert scale, which was objective and aimed at observing the perception of specific points.

RESULTS

All 14 students enrolled in the course answered the questionnaire. No loss was observed.

Students perception

It is possible to observe that all students point out that they are enjoying the activities, as well as they perceive that they can learn with the methodology used. However, a small portion of students (14%) still reported preferring the dialogic exposure methodology only (Table 1). Concerning Peer Instruction favoring the learning process, 35.7% of the students reported that it greatly facilitates the learning process, while 57.1% stated that it facilitates.

Table 1. Description of students' perception of *Peer Instruction* and the methodology. (n=14)

Questions	%
In a general way, are you enjoying the classes?	
Yes	100%
No	0.0%
Do you feel that you are managing to learn with the methodologies used?	
Yes	100%
No	0.0%
Comparing the Peer Instruction with the dialogued lecture, which of the two learning methodologies Do you perceive as more efficient?	
Peer Instruction	85.7%
Expositive lecture	14.3%
Regarding the Peer Instruction methodology, Do you realize that it has favored your learning process?	
Yes, a lot	35.7%
Yes	57.1%
Intermediary	7.1%
No	0.0%
No, not a bit	0.0%
Regarding the Peer Instruction methodology, Do you realize that it has helped your ability to solve problems?	
Yes, a lot	21.4%
Yes	50.0%
Intermediary	21.4%
No	7.1%
No, not a bit	0.0%
Regarding the Peer Instruction methodology, Do you realize that it has facilitated the retention of knowledge/skills worked on?	
Yes, a lot	26.6%
Yes	64.3%
Intermediary	7.1%
No	0.0%
No, not a bit	0.0%

The point that least favored the methodology addressed was the aid of the method is the ability to solve problems. While 50% answered that the technique facilitates this process, 21.4% answered that it facilitates in an intermediate way. 7.1% answered that they do not perceive the technique as a facilitator in the process of developing problem-solving skills. However, a large part of the students pointed out the technique as important to aid in the retention of knowledge (64.3% yes; 28.6% a lot).

We can see the distribution of students' responses to the *peer instruction* teaching strategy in Figure 2. Students perceive the method mainly favoring attention in class and as an aid in the understanding of the concepts worked. On the other hand, in general, students perceive that the methodology is not so interesting to help their participation in the class. Nevertheless, all students recommended that the *peer instruction* teaching strategy continue to be used as a tool in the teaching and learning process.



Figure 2. Students' responses to the peer instruction teaching strategy. (n=14)

Speech analysis

Students were also openly questioned about the positive and negative aspects of the technique. We can observe (Table 2) that students perceive a great possibility of promoting discussion in the classroom: "It makes us stop and reflect". In addition, several arguments were made concerning an improvement in the understanding of the concepts worked, which can be represented by a sentence enabling a greater understanding of the concepts". Dynamicity, attention, and instantaneous feedback were other positive points pointed out in the described method; however, some students reported that they still prefer the traditional exposure method. Arguments about less content covered during the class were also described by the students: "We should discuss more the books, cover more knowledge" as well as possible disruption of the class rhythm in some situations that can "break" class rhythm".

Table 2. Analysis of students' discourse regarding the teaching strategy guided by active methodologies Peer Instruction.

	Categories	
Positive points	Dynamicity	"...makes the class more dynamic and interactive" "greater interactivity..." "dynamicity, student protagonism in the learning process,"
	Discussion and Reflection	"It makes us stop and reflect" "Open a space for the discussion..." "We were able to reason and think about the content..." "Allows us to reflect on the knowledge we have" "Motivates my discussion with colleagues" "... reflection on one's knowledge, allowing it to be corrected or fixed"
	Understanding	"... We can confirm if we understand" "I can see a more concrete result" "Details go unnoticed during the exposition of the class and in the question, we can resume something that was left or reconstruct what we understood wrong" "...it facilitates learning" "...enabling a greater understanding of the concepts" "We were able to absorb the content much better, [...] it facilitates assimilation."
	Attention	"... Demands more of our attention" "... The <i>Peer Instruction</i> technique demands more of us" "I have to pay more attention in this type of class" "Needs us to pay more attention in class"
	Feedback	"...if it is incorrect (knowledge), it allows correcting it right away when discussing the alternatives" "... it helps me to control my learning" "Possibility of misunderstanding error correction of (content) issues virtually instantaneous"
Negative points	Personal preference for the traditional method	"I think a dialogue class is better" "I prefer the lecture with a discussion of previously conducted directed studies."
	Less content covered	"... We should discuss more books, cover more knowledge"
	Others	"... Sometimes I get distracted by the method" "... In some situations, they can "break" the rhythm of the class" "Not all students "immerse themselves" in this methodology, refraining in the discussion moments. Nothing that doesn't happen with other methodologies."

DISCUSSION

We can observe from the analysis of students' perceptions, that Peer Instruction seems to be an interesting tool for building active learning and can innovate the classroom. The present method favors – through the student's vision – the increase of attention, a greater discussion of the topics, as well as a greater understanding of the worked concepts.

All students recommended the use of the learning strategy, in the same way, that all reported they were learning, even though a small portion of this group still preferred traditional teaching approaches.

The peer instruction methodology can be an interesting strategy for Professors who want to transform the dynamics of their classes. While methodologies such as Problem-Based Learning, Case Method, Problematisation, and other formats of active teaching strategies require a complete change in the format of pedagogical dynamics and high skill of the professor to conduct^{9,12,25}, Peer Instruction can be an easier alternative for this group of professors who aim at the more active participation of students. The present method does not require great skills of mediation of discussion from the Professors and the conduction of the teaching strategy is easily applicable in large classes, where other active strategies can be difficult to implement. Thus, a shift from passive classes to more active classes can be achieved through Peer Instruction. Professors can adapt their lectures to the Peer Instruction model easily; thus favoring the active participation of students^{10,14}.

Several students pointed this out as one of the main advantages of the method, being able to quickly identify possible comprehension errors. Thus, the professor can resume concepts that were not clear at the time they were discussed or move on when understood by the students. In addition, there is a favorite of the discussion process among students. It is important to emphasize that in the present class, a large portion of the students have an introverted psychological profile and several other techniques aimed at the discussion were not very successful with the class. However, because the discussions are mostly with colleagues who sit next to each other (usually the distribution is by affinity) small group discussions are favored. Such students who would eventually be afraid to speak out in front of the whole class tend to discuss conceptual problems with their colleagues. In addition, as Peer Instruction aims to discuss the answers and convince the colleague of the correct one, argumentation skills are indirectly worked on.

Another important factor for Peer Instruction to be leveraged concerns collaboration between students^{15, 21, 26}. Collaboration is one of the desired skills for 21st-century students. Students need to cooperate and learn from each other. In this way, it is important that the Professors stimulate and maintain an environment of cooperation and circumvent any beginning of competition between students during the use of this teaching strategy. Such a factor can be a little complex in traditional courses that often stimulate competition among students. However, teaching cannot and should not be guided by a competitive environment. Furthermore, the simulation of discussion among students and the possibility for them to explain their answers to their colleagues is highly desired. This improves the learning of those who are listening and enhances the knowledge of those who are explaining.

Mazur¹⁰ reports that often the student due to having recently learned to concept and consequently having just overcome any difficulties, can more easily present an explanation to the colleague, often with greater ease than the professor. Mainly the fact that the student will present the explanation in a simpler and more colloquial language, favoring the process of the initial understanding of the student who listens carefully to the explanation of the colleague. Furthermore, the process of explaining to other colleagues was described by Dale (1969)²⁷. In this approach, the author presents seven different forms of learning, which he calls the learning pyramid. At the top of this pyramid would be the traditional teaching way, where students would be able to retain only 5% of the knowledge work. Reading would be right after (10%)²⁷. Nevertheless, at the base of the pyramid, the strategy for greater retention of knowledge – around 85% – would be in the approach of teaching others²⁷. In addition to favoring the learning process of colleagues who would still have difficulties, the Peer Instruction teaching strategy would allow the students who understood the concepts to explain them to other colleagues, favoring their learning.

Crouch and Mazur¹⁴ reported that many students switch from wrong answers to right answers after discussion with their colleagues. Meanwhile, the opposite is hardly the case: switching from the right answer to the wrong one. In their studies, this occurred in only 3% of the changes. The reason for this is explained by the fact that it is easier to change the mind of someone wrong than someone who is right¹⁰. Besides, in this study, students' confidence in their answers was measured, noting that after the discussion, students tend to have more confidence in their answers, because, through discussion, they tend to consolidate and reinforce the reasoning that built the right answer.

One of the negative points attributed by the students to the Peer Instruction teaching strategy concerns the time required to be longer than an exhibition, which would influence less content covered in class. This is true, Peer Instruction requires a longer time for the discussion, and this was pointed out by a student in the negatives. However, with Peer Instruction it is possible to delve more deeply into Bloom's taxonomy of the points worked²⁸, while in a conventional theoretical exposition, memorization is often worked (lesser complexity of the cognitive process), and the discussion often requires higher stages of cognition²⁸. This leads to understanding itself and not to mere memorization.

In order not to reduce the approach of the contents that might be converged in a traditional class, the use of

complementary guided studies can be an interesting strategy to deal with this difficulty. This is one of the strategies frequently used to circumvent this problem by our group of professors. In addition, it is necessary to reflect on the content approach. This is an issue that is often discussed and pointed out as a problem for teaching strategies guided by active methodologies. However, considering all the possible knowledge of the specific areas worked with the students, it will never be possible to approach and work all the available content referring to a specific topic, even using lectures, as the vastness of knowledge is enormous even in specific areas. On the other hand, when our pedagogical practice is no longer focused on content and is based on an approach based on skills and competencies, the content serves as a mere instrument for achieving these competencies. Thus, students who develop the competence of permanent education – learn to learn – and can critically read, will be able to approach all the contents that are necessary for them during their professional life, while the same cannot be observed in professionals who do not develop such skills and competencies during their academic training.

CONCLUSION

From the observation of the professors and reports of the students, it was possible to consider that Peer Instruction can be used as a teaching and active learning strategy in dental courses. The method seems to favor mainly attention, discussion, and understanding of concepts. However, problem-solving skills seem to be less facilitated. The present teaching strategy can be an interesting tool for teachers who aim to transform their lectures into active approaches.

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