



Evaluation of different teaching methodologies by assessing the performance of dentistry students

Avaliação de diferentes metodologias de aprendizagem aferindo o desempenho de estudantes de odontologia

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ABSTRACT

Objective: The aim of this study was to compare the performance of day- and evening-class students in the first semester test of Dental Materials in the School of Dentistry at São José dos Campos - UNESP, who were exposed to traditional lectures (TRAD) and Team-Based Learning (TBL). **Material and Methods:** The results of Dental Materials first semester test of students, from day and evening classes of 2016 were tabulated and analyzed in this research. The groups formed for the execution of the methodology were randomized using the individual global average of the previous year of the students, and the groups were composed of 6 to 7 members, maintained throughout the course. During the correction of the tests, the subject of each question and the applied methodology (TBL and TRAD) were identified. Responses of each question were graded separately according to the subject for comparison between methodologies. A total of 88 tests were evaluated. The performance was evaluated through a comparison of the average grade of each question, related to a specific learning methodology. The data were submitted to t-test. **Results:** The students' overall performance was similar when both methodologies were compared. Students from day class presented higher grades with TBL whilst evening class students presented better performance in questions with traditional lectures. **Conclusion:** Active learning should be further implemented in Brazilian Dental Schools to change students' habits aiming to improve their personal and social skills besides of professional technical knowledge.

KEYWORDS

Educational activities; Dental Schools; Learning; Student evaluation; Higher education.

RESUMO

Objetivo: O objetivo deste estudo foi comparar o desempenho de alunos dos turnos diurno e noturno na prova do primeiro semestre da Disciplina Materiais Dentários da Faculdade de Odontologia de São José dos Campos - UNESP, expostos a aulas tradicionais (TRAD) e Aprendizagem Baseada em Equipe (TBL). **Material e Métodos:** Os resultados da prova dos alunos, dos turnos diurno e noturno de 2016, foram tabulados e analisados. As turmas utilizadas para a execução da pesquisa foram randomizadas utilizando-se a média global individual do ano anterior dos alunos, sendo as turmas compostas de 6 a 7 integrantes, mantidas ao longo do curso. Durante a correção das provas, foram identificados os assuntos de cada questão e a metodologia aplicada (TRAD e TBL).

As respostas de cada questão foram graduadas separadamente de acordo com o assunto para comparação entre as metodologias. Um total de 88 testes foi avaliado. O desempenho dos alunos foi avaliado por meio da comparação da nota média de cada questão, relacionada a uma metodologia específica de aprendizagem. Os dados foram submetidos ao teste t. **Resultados:** O desempenho geral dos alunos foi semelhante quando comparadas as duas metodologias. Os alunos do período diurno apresentaram notas mais altas no tratamento TBL, enquanto os alunos do período noturno apresentaram melhor desempenho nas questões com aulas expositivas tradicionais. **Conclusão:** A aprendizagem ativa deve ser mais implementada nos cursos de graduação em Odontologia, no Brasil, para melhorar as habilidades pessoais e sociais dos alunos, além de aperfeiçoar o conhecimento técnico profissional dos discentes.

PALAVRAS-CHAVE

Atividades educacionais; Faculdade de Odontologia; Aprendizagem; Avaliação do aluno; Ensino superior.

INTRODUCTION

Education is a very powerful instrument for social change and transformation, and innovative teaching practice is the only way to enhance the quality of education [1]. Teaching activity presupposes a ritual that involves the participants in the process, learners, and teachers. In adult education, this process should be built on the premise that adults learn differently. Thus, it is the teachers' responsibility to equip themselves with conceptual and practical-theoretical tools to achieve their goals [2].

For a long time in the history of education, the teacher was a content transmitter and the student a reproducer - passive listener with receptive attitude - without reflexive thinking. The traditional lectures with predominance of oral exposure, predetermined and fixed sequence of contents, and repeated exercises focusing memorization of the content can be easily found in many 21st century higher education institutions. It follows an extremely conservative paradigm, in which the pursuit of highly specialized technical efficiency separates reason from feeling, body from mind, and science from ethics [3,4].

The model of higher education affects professionals' skills [5,6], especially humanization, which combined to the accelerated development of digital technologies highlights the need for transformation. The revision of teaching strategies has become necessary because traditional pedagogy, used in most educational institutions, is proving to be insufficient to keep up with the speed of progress in our society, thus dictating new national curricular guidelines [7,8].

Higher education institutions have, among their duties, to dispose and make educators aware of the mission of teaching theoretical content and to encourage students to develop

reflection on the implications of the results of scientific research in dental practice. In addition, according to the National Curricular Guidelines of the Undergraduate Course in Dentistry [9], the pedagogical project should be built collectively, centered on the student, and supported by the teacher as a mediator of teaching-learning process. It is important to adopt pedagogical concepts that associate theory to practice, and active learning can facilitate this process of "learning to learn" It should also use methodologies which will allow the active participation of students in this process, the integration of knowledge of the basic sciences with that of the clinical sciences, and the establishment of scientific initiation programs as a learning method [10].

Intrinsic motivation of students has shown to be important for learning because it has been associated to more effort spent on tasks and activities and desire to learn [11-13]. In this sense, new teaching-learning methods may enhance intrinsic motivation [14] and facilitate their commitment [15,16]. According to [4] the present century poses a great challenge for the development of individual autonomy in association with the collective. In this context, it is education, through a critical, ethical, and reflexive pedagogical practice, which should trigger interdependence and transdisciplinary approach in individuals. Building a critical consciousness requires creative curiosity, and in this process, students are active and aware that reality is always changeable. Moreover, the reflexive thinking can only be induced by active, dialogical, and participatory teaching-learning methods, the modification of the programmatic content of education and the use of techniques, such as reduction and codification. It is only with the development of dialogue that we can overcome the anti-dialogue attitude, so present in our cultural historical formation [17].

Many active learning methods have been described: problematization, problem-based learning (PBL), team-based learning (TBL), flipped classroom, seminars, critical experience reports, socialization, round tables, thematic debates, workshops, commented reading, movies, musicals, dramatizations (role-play), playful-pedagogical dynamics, and portfolio, among others [18,19].

TBL, based on constructivism, places the professor as a facilitator and promotes dialogue and collaborative interactivity of students. Thus, knowledge is aggregated and reconstructed in a concrete and meaningful learning process [20].

Studies from health science courses have shown an overall improvement in student performance who has classes in active format, using the TBL method [21,22]. Studies have been reported the TBL as a more efficient methodology compared to traditional teaching in dentistry [23,24].

When faced with the increase in the number of students, educators' questions themselves about the feasibility of maintaining its preferred teaching technique, based on passive learning or focus on based on group work and focused on content application. Other doubts arise [25]. How not to prioritize the use of lectures? How to stimulate motivation from the students? How to ensure they arrive prepared for the study?

The aim of this study was to compare the performance of day- and evening-class students in the first semester test of Dental Materials in the School of Dentistry at São José dos Campos - UNESP, who were exposed to traditional lectures and TBL. The null hypothesis was that: there were no differences between TBL to traditional lectures on mean grades of test responses, and there were no differences between class periods performance regarding to teaching-learning method.

MATERIALS AND METHODS

The results of Dental Materials first semester test of second-year dental students, from day and evening classes of 2016 were tabulated and analyzed in this research - approved by Research Ethics Committee - No. CAAE: 01908018.0.0000.0077. Teachers used TBL and traditional lectures (TRAD) for both class periods, alternating between them, i.e., a topic taught with TBL in day class was addressed by TRAD in the evening class and vice-versa.

The groups formed for the execution of the methodology were randomized using the individual global average of the previous year (1 year) of the students, and heterogeneous groups were composed of 6 to 7 members, combining students from different performances.

Methodological care was taken to approach the themes in a cross-sectional way during the planning of the teaching plan and carrying out the activities throughout the semester. The assessment instrument was the same between school periods, which consisted of 10 essay questions, thus all students, from day and evening classes, took the same type of test, however the tests were different between the classes. The tests were applied in the same day for both classes but at different times, respecting the time the course was offered. Thus, both classes were submitted to similar temporal distance from classes to evaluation.

The test, that consisted of ten questions, from which the information on the identification of the teaching strategy is contained in Table I. The tests were prepared by a group of professors (5, being 1 effective and 4 substitutes) of the discipline, who graded the degree of difficulty of each question and ensure fairness between the tests in the two school periods. All 10 questions had the same weight in the final grade of the students' test. The tests were part of the regular evaluation of the discipline and the correctors had access to the student's identification.

Table I - Theme of each question and the methodology for each class in both periods (day and evening class). Traditional lectures (TRAD) and Team-Based Learning (TBL) methodology

Class topic	Methodology
Alginate	Day class TBL
	Evening class TRAD
Acrylic resins 1	Day class TBL
	Evening class TRAD
Acrylic resins 2	Day class TBL
	Evening class TRAD
Elastomeric impression material	Day class TRAD
	Evening class TBL
Metal alloys	Day class TRAD
	Evening class TBL
Metal casting	Day class TRAD
	Evening class TBL

The subjects of the questions were: impression materials - alginate; acrylic resins (two questions); elastomeric impression material; metal alloys and casting (two questions). During the correction of the tests, the subject of each question and the applied methodology were identified. Each question was valued from 0 to 10, thus facilitating the scale for partial answers. Responses of each question were graded separately according to the subject for comparison between TBL and TRAD (Table II). A total of 88 tests were evaluated, 50 from day classes, and 38 from evening classes.

The evaluation of the tests had a blueprint for its correction in order to reduce subjectivity, and the correction was guided by a template formulated jointly by 2 professors (1 substitute and 1 permanent), to minimize discrepancies.

The data were tabulated and submitted to t-test (Excel MS, Microsoft). The average of each question was compared by the method used in the classes, as well as by comparing the averages of the grades obtained in classes covered by TBL and traditional lectures. Statistical analyses were performed with a significance level of 0.05.

RESULTS

The subject of questions, teaching methodology in each class period, and the students' performance in each response, separately, are presented in Table II. A low mean grade was observed for the response of question #6 and #4 by day class and evening class students, respectively, which decreased the overall average for TBL method, as well as for the response of question #6 by day class that decreased the average for TRAD method.

The mean grade for each teaching method is presented in Figure 1, which showed to be similar to each other.

The comparison between student's mean grade in relation to the teaching method and class period was showed in Figure 2. Data followed normal distribution according to Anderson Darling ($p=0.12$; $\alpha=0.05$). Teaching methodologies, TBL and TRAD, showed to be similar for each class period ($p = 0.409$ and $p = 0.114$; t-test). Students from day class presented higher grades with TBL whilst evening class students presented better performance in questions with traditional lectures.

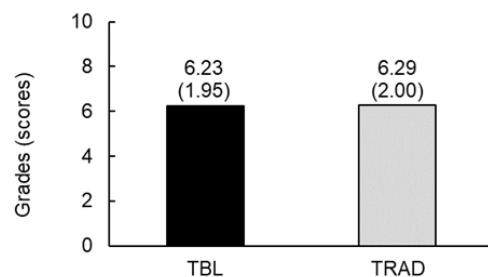


Figure 1 - Mean grade (S.D.) for TBL – Team based learning and TRAD – traditional method, similar to each other ($p = 0.96$; t-test). Source: Prepared by the authors.

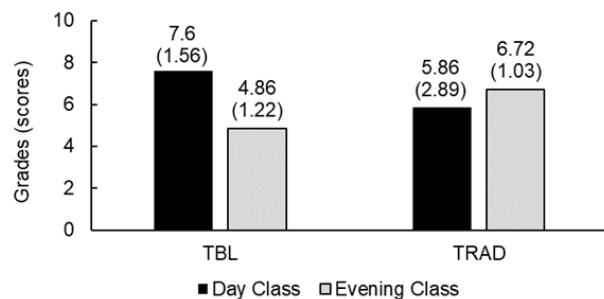


Figure 2 - Mean grade (S.D.) in relation to the teaching method and class period. TBL – Team based learning and TRAD – traditional method. Teaching methodology showed to be similar for each class period ($p = 0.409$ and $p = 0.114$; t-test). Source: Prepared by the authors.

Table II - The subject of each question, teaching methodology (TBL/ TRAD) in each class period, and the students' performance in each response

Question	Subject	Teaching methodology: Grades	
		DC	EC
1	Alginate	TBL: 8.58	TRAD: 7.91
2	Acrylic resin 1	TBL: 5.81	TRAD: 6.14
3	Acrylic resin 2	TBL: 8.42	TRAD: 6.11
4	Elastomeric impression material	TRAD: 8.02	TBL: 3.54
5	Metal alloys	TRAD: 6.98	TBL: 5.94
6	Metal casting	TRAD: 2.58	TBL: 5.10

DC – day class, EC – evening class, TBL – Team based learning, TRAD – traditional lecture. Source: Prepared by the authors

DISCUSSION

Many teachers are changing the way they teach, by replacing the traditional class in which students often just listen, repeat, and occasionally ask questions, with classes considered as more dynamic. One of the main tasks of higher education is to involve students in active learning [23]. This change is due to the influence exerted by national curricular guidelines that recommend student-centered teaching strategies, in which the pedagogical project is collectively constructed and centered on the student as a subject of learning, and the teacher plays the role of facilitator and mediator of the teaching-learning process [8]. In this context, higher education institutions are increasingly being encouraged to change the way they teach, making teachers and students learn from new networks of knowledge and thus training professionals capable of dealing with the social reality that will be found in their professional life [3,25]. Consequently, the professor should share information using different approaches so that students can choose which are better suited to their learning needs, and then focus on out-of-class study [26-29]. However, active learning is still new in many Brazilian Dental Schools. Unfamiliarity of professors and students to these teaching-learning methods has impaired the implementation in daily classes, being necessary to invest in training professors in active learning methods [30-32].

The new methodological practices of teaching need time for their adaptation and consolidation. The classes of 2016 were the first ones to be exposed to TBL in the course of Dental Materials. The students' overall performance was similar when both methodologies (TBL and TRAD) were compared. Thus, the first null hypothesis that there were no differences between TBL to traditional lectures on mean grades of test responses was accepted. However, it is necessary to emphasize that this was considered the first contact of the students with the active TBL methodology, and since the period of establishment of this methodology and the way students prepare for classes improves with sequential sessions over time, this average tends to rise. Moreover, the students' adaptation to the methods and the time of use of the methodologies by the teachers also determines their consolidation [30].

Implementing TBL or some other methodology that has inverted classroom philosophy creates

space for concrete learning where students adopt the role of cognitive learners to practice thinking as a specialist within their field [31], in a discipline in which the theoretical content must be aligned with the practical content, as is the case in the dental materials discipline of the undergraduate dentistry course. The development of this type of methodology allows the student to create a consistent reasoning of concepts at the time of performing the practical activity. Team-based learning approach increase dental students' performance because students were provoked to think and clarify problems rather than commonly memorize accurate knowledge [33].

Despite there were no differences, higher mean grades were achieved with different teaching-learning methodology in different class periods. Day class students presented superior performance with TBL while evening class students achieved higher mean grades with traditional lectures. Therefore, the second null hypothesis that there were no differences between class periods performance regarding to teaching-learning method was rejected. In Brazil, double shift is often a reality for students of evening classes, where work and study are reconciled [34]. It could have reduced the available time for out-of-class study jeopardizing the performance of students in TBL classes and consequently, in the questions related to these subjects.

TBL, besides other collaborative active learning methods, creates space for concrete learning. Students can develop technical professional knowledge skills to solve increasingly challenging problems [31]. In this scenario, one of the drawbacks of the present study was that students' individual contribution to the group was not assessed [35]. Collaborative active methods also allow students to develop/enhance their emotional intelligence [36], which showed to be important because of its influence on students' learning behavior [37]. According to some authors [38,39] motivation can be divided into intrinsic, which involves the inherent satisfaction produced by acquiring new science knowledge, and in extrinsic motivation, which involves learning science as a means to a concrete end [40]. Two scales were introduced to the classical scale termed extrinsic motivation, i.e., grade motivation, related to short-term goals, and career motivation, related to long-term goals [39], which more clearly target the objectives that students perceive to be

important at this stage of their education [41]. According to Twenge (2013) [42], allowing generation Z workers small career leaps, such as acting as a preceptor for students, can help to install and cultivate confidence. This principle can also work for generation Z undergraduate students. Thus, group study could be important when considered as a space for peer-instruction teaching and learning.

The results of this research corroborate previous studies that have demonstrated that TBL method is a promising way to teaching in dentistry course [43-45]. The complexity of subjects also showed to influence on the effectiveness of teaching-learning method and consequent students' performance. However, it was considered that active learning methods can be successfully implemented. It should be emphasized that time is a fundamental factor for the long-term success of active learning methods [31]. Further studies about in-class daily practice in Brazilian Dental Schools involving active learning should be performed to increase data and exchange of experiences focusing improvement of teaching learning process in Dentistry.

One limitation of this study is that no courses is yet being fully offered using TBL as a teaching strategy at the university where the research was carried out; so, it would be interesting a comparison between different teaching methodology for classes that had completed the entire course in the TBL or traditional method in each term. Thus, there is an open subject for further studies.

CONCLUSIONS

Based on the results, the following conclusions were made:

- general performance of students was similar when comparing TBL to traditional lectures;
- TBL was more effective in day class. On contrary, traditional lectures were more effective in evening class;
- the complexity of subject presented an important role in students' performance.

Active learning should be further implemented in Brazilian Dental Schools to change students' habits aiming to improve their personal and social skills besides of professional technical knowledge.

Author's Contributions

MMGG: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft Preparation, Writing – Review & Editing. RNT: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft Preparation, Writing – Review & Editing. VRS: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft Preparation. VSSB: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft Preparation, Writing – Review & Editing. MS: Conceptualization, Methodology, Formal Analysis, Investigation. SR: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft Preparation, Writing – Review & Editing.

Conflict of Interest

The authors declare no conflict of interest.

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Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of Research Ethics Committee of ICT/CSJC – UNESP. The approval code for this study is: CAEE 01908018.0.0000.0077.

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