Method 300: a complementary teaching methodology in Dentistry

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Abstract

This study evaluated Method 300, a complementary teaching methodology in Dentistry. Thirty participants were divided into 6 groups according to the scores obtained in a placement test ranging from 0 to 10. Students with scores lower than 6 were classified as having poor academic performance; students with scores equal to or greater than 6 were considered as having good academic performance. Each group included at least one student with good performance. Our methodology consisted of two application cycles, each including one different test; however, only students with low performance could undergo the second testing. Students held meetings twice a week for one hour and thirty minutes. Of the 54 students initially enrolled in the subject, 24 dropped out, leaving 30 students who completed all the proposed activities. In cycle 1, 24 (80%) students showed poor academic performance and 6 (20%) good. Students with poor performance in P1 significantly improved after P1 300 test application ($P < 0.001$). After cycle 1 activities, all 30 participants showed significant improvement. In cycle 2, the number of students with good performance tripled when compared to cycle 1, resulting in a decrease in the number of students with poor performance ($P = 0.205$). Results show that the Method 300 is an important teaching–learning resource in Dentistry, to be used as a complementary methodology to lectures.

Introduction

Due to current dynamic and easy access to information, the teaching–learning process in Dentistry has been rethought [1, 2]. Virtual libraries, search engines, free access to scientific production, and videos, among other possibilities, have changed the student profile: from object, they are now the subject of learning; the teacher, in turn, plays the role of mediator in the process of constructing scientific knowledge [3].

Traditional and active teaching methodologies have been investigated by numerous fields of knowledge, with discussions on the best way to promote learning [1, 4]. In Dentistry, classes with active teaching methodologies have gained prominence [2, 5]. Problem-Based Learning (PBL) method, characterized by applying the knowledge acquired soon after learning [6], has been adopted by US medical schools since 1969, being established with satisfactory results in the 1990s [7, 8].

First-year students' background varies widely, since most leave high school—where learning may have been insufficient and left gaps that will affect the student's academic trajectory—straight into university. In Dentistry, the undergraduate profile includes students from public and private schools, aged between 17 and 20 years, the so-called young adults [9]. Research shows that, unlike university students, this age group retain more information with less traditional teaching methodologies because they are still in the high school learning continuum. It is thus paramount to

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investigate the efficiency of teaching methods in this young audience, comparing it with the adult group [6].

To fill the possible teaching gaps left by secondary education, we proposed a complementary teaching–learning strategy called "Method 300," in a clear allusion to Sparta, a civilization remembered for its "desire for excellence" [10, 11].

This methodology combines concepts from the inverted classroom, such as Peer Instruction (PI) and Team-Based Learning (TBL), enabling a sharing of ideas that aims to form pairs or teams so that learning can be built together [11]. To promote knowledge, solve problems, and work together, students use tools, such as academic games, Google scholar, smartphone applications (Apps), podcasts, and videos, thus allowing learning and teaching to happen simultaneously [12]. By means of cloud content storage, the teacher shares supplemental and basic curricular materials, used by students to prepare for group meetings. Low-performing students not only read the material and watch the videos but also ask questions to the teacher for clarifying doubts and discuss the subject with their classmates. Thus, this teaching model places the student as the protagonist of learning [11, 13].

Method 300 showed satisfactory results in reducing failure rate and increasing the participants' grade when applied in Architecture and Engineering courses [11, 12], but the strategy has yet to be explored in Dentistry. Thus, this study sought to evaluate the Method 300 applied in the Dentistry course at Universidade São Lucas, Rondônia, Brazil.

Methodology

Sample selection

Approved by the Research Ethics Committee (CEP 2.444.939), this study was conducted at the Preclinical I (Periodontics) class of the Dentistry course of Centro Universitário São Lucas (UniSL), Porto Velho, Rondônia, Brazil. The subject of Periodontics was selected based on a list provided by the course coordination, containing the subjects with the highest failure rate among students whose curriculum is a prerequisite for developing clinical activities in patient care. Preclinical I (Periodontics) is a semiannual module taught through theoretical–practical classes, including traditional lectures and problem-based learning of prevention, diagnosis, prognosis, and treatment of clinical manifestations of periodontal disease. Practical activities are performed in a multidisciplinary laboratory with simulation manikins. Course evaluation consists of two theoretical–practical assessments (P1 and P2) with scores ranging from 0 to 10, whereby students must reach an average score equal to or greater than 6 to be approved. All 54 students

(mean age of 19.8 years) regularly enrolled in the course of Periodontics were invited to participate in this study and signed the Informed Consent Form (ICF). Students who were not receptive to the methodology had no availability to participate in activities and meetings, and those who did not sign the ICF were excluded from this study.

Data collection

Data were collected by means of two tests, P1 300 and P2 300, applied in two cycles. The two cycles were formed using a level test, which consisted of the institutional tests elaborated by the responsible professor and revised by the collegiate institution according to the internal guidelines. To ensure the autonomy of the professor, this study authors did not participate in the test elaboration nor in the selection of questions from the institutional database.

This study was conducted with thirty students randomly divided into six groups ($n = 5$). For guaranteeing randomicity, the level test scores were reordered in descending order and all students received numbers from 1 to 6, so that students who received equal numbers assembled the same group—for example, those who received number 2 formed group 2. The role of students within the groups was determined based on P1 test score: students who scored below 6 were classified as having low academic performance, whereas those with scores equal to or higher than 6 were group leaders, providing assistance to their peers.

The purpose of dividing students into groups was to promote collaborative learning, for this method provides greater interaction among students and thus raises awareness regarding colleagues' difficulties. By developing exercises and challenges for low-performing students, high-performing students would review the subject already learned and provide full support for their peers through meetings and stimuli.

A series of specific objectives were outlined for low-performing students before repeating the test, which included questions from the institutional questions bank on the same didactic content as the first test, namely, (a) attending all classes of the subject; (b) participating in two weekly meetings lasting one hour and thirty minutes; (c) solving the exercises and tests proposed by the professor; (d) solving the exercises and challenges prepared by high-performing students; (e) reading the literature suggested by the professor; and (f) reading the basic curriculum contents. Thus, these students were granted access to the basic curricular contents of the classes for conducting studies prior to group meetings.

High-performing students could not repeat the test, but they could improve their grades by collaborating with and encouraging low-performing peers upon (a) participating in two weekly meetings lasting one hour and thirty minutes; (b) developing exercises and challenges for their

colleagues to solve; (c) encouraging their colleagues and providing all the necessary assistance; and (d) reading the literature suggested by the professor.

In this scenario, the professor plays the role of manager and advisor, at both collective and individual levels. For that, they must develop challenges and exercises; suggest auxiliary bibliography; clear doubts and moderate discussions, questioning and posing problems; direct the group toward a common task; and request resources from the university. As to not inhibit students' expression, the professor does not participate in the weekly meetings; however, an assistant must follow the meetings, transmit eventual doubts, and provide a feedback on activities progress. Preferably, meetings should be held in an environment connected to wireless network for the use of technologies and include video projectors with external speakers, as well as a whiteboard.

To stimulate assistance to classmates with difficulties, students with good academic performance could improve their scores by means of a bonus according to the improvement in their peers' performance and the level of assistance provided. Such a bonus was determined based on a five-point Likert scale questionnaire used to assess the perceived support according to low-performing students, whereby 1 classified an unsatisfactory support; 2 reasonable; 3 good; 4 very good; and 5 excellent. High-performing students who provided support for their peers answered the same questionnaire. The final support level was measured based on the average of the two scales values and on the scores improvement of low-performing students (Table 1).

Finally, all participating students assessed the study methodology by means of an anonymous questionnaire, thus reducing the chances of false positive responses and the risk of compromising the study evaluation.

The pass rate at the end of the semester was determined based on the grades obtained in the subject, without considering the Method 300, through the formula $P1 + P2/2$. Students were considered approved if their final grade was equal to or greater than 6. The pass rate after the methodology application was calculated based on the grades obtained in the subject plus the 300 Method test results, using the formula $P1 + P2 + P^1 300 + P^2 300/4$, according to the same criteria mentioned above.

Data analysis

Data were tabulated in the Microsoft Office Excel program (2020) and processed using SigmaPlot software (12.0). After verifying that data met the normality requirement using the Shapiro–Wilk test, the paired t test was applied.

Descriptive statistics was used to calculate the median value. The paired-sample t test was used to determine statistical differences between student grades, mean, standard deviations, and standard error. Significance level was set at $P = 0.05$.

Results

Fifty-four students agreed to participate in this study by signing the informed consent form. However, after the beginning of activities, 24 (44%) were excluded for disrespecting the study methodology.

In the first cycle of activities, 24 (80%) students achieved a poor academic performance and 6 (20%) a good performance, becoming group leaders. The mean score of low-performing students in the P1 test was 3.17 (max 4.5 and min 1). After P1 300 method application, the mean increased considerably (142%, with $P < 0.001$), reaching a value of 7.67 (max 10 and min 6). After the first cycle of activities, all 30 participants showed significant improvement (Table 2).

The number of students with good performance tripled in the second cycle when compared with the first cycle, totaling 18 students. Consequently, the number of low-performing students decreased by 50%. However, we verified no statistically significant difference in the improvement of low-performing students between P2 and P2 300 ($P = 0.205$).

At the end of the semester, students' pass rate was 20% and failure rate 80%, with an overall final grade of 4.5 without considering the Method 300. After applying the methodology, these rates were 60% and 40%, respectively, with an overall grade of 6.5, thus evincing the effectiveness of the methodology in increasing pass rate.

Regarding students' perceptions about the Method 300, 29 (96.6%) students totally or partially considered that group meetings were good opportunities for studying, and 22 (73%) agreed that participating in different groups for each

Table 1 Criteria to increase the grade of students with good performance

Increase in the grade of the student with poor performance	Level of aid				
	1	2	3	4	5
Increase 0–1	0.00	0.25	0.25	0.50	0.50
Increase greater than 1 for final grade less than 6	0.00	0.25	0.25	0.50	0.50
Increase greater than 1 for final grade equal to 6	0.00	0.25	0.50	0.75	1.00
Final grade increases greater than 6	0.00	0.25	0.50	1.00	1.50

Table 2 Statistical the range, maximum scores, minimum scores, median scores, mean, standard deviation (SD), standard error of the mean, and P values of distribution of test scores from both groups

Group	N	Range	Max	Min	Median	Mean	SD	SEM	Test t value P
Cycle 1 (P1 × P^{1}300)									
Test P1	30	7.5	8.5	1	3.600	3.963	1.874	0.342	< 0.001
Test P^{1}300	30	4	10	6	7.700	7.767	1.044	0.191	
Test P1*	24	3.5	4.5	1.0	3.000	3.175	0.979	0.200	< 0.001
Test P^{1}300*	24	4.0	10	6	7.600	7.671	1.040	0.212	
Cycle 2 (P2 × P^{2}300)									
Test P2	30	6.5	8.5	2	6.500	5.810	1.886	0.344	0.406
Test P^{2}300	30	8	9	1	7.000	5.890	2.432	0.444	
Test P2*	12	3.5	5.5	2	3.500	3.817	1.117	0.323	0.205
Test P^{2}300*	12	5.3	6.3	1	3.000	3.308	1.609	0.464	

P value Cycle 1 (Test P1 vs Test P^{1}300; Test P1* vs Test P^{1}300*), Cycle 2 (Test P2 vs Test P^{2}300; Test P2* vs Test P^{2}300*)

*Within each cycle this item only considers the grades of students with poor performance

exam was an interesting experience. Moreover, 21 (70%) students fully or partially agreed that the method allowed students to know each other better, thus proving to be effective in promoting interaction among students. Twenty-nine students (96.6%) felt good about retaking the exam after the study group, and the perception that the method should be employed in different fields was unanimous among participants. The general acceptance of the method was determined based on the answers to the questionnaires, which were evaluated and counted by item, indicating that 131 responses (87.3%) remained between fully and partially agree, thus demonstrating a good general acceptance. Table 3 shows the results of students' perceptions about the questionnaires.

Discussion

This study sought to evaluate a new teaching methodology applied to a dental school. The results indicate that the method was effective in improving overall academic performance, for the class mean grade increased from 4.03 to 7.67 after the application of the first cycle—a 90.5% increase. This methodology real impact is evident by the fact that 100% of students classified as having a poor performance according to the level test obtained a great improvement after the first cycle application. In a study conducted in a Physiotherapy course, authors found the class mean grade to improve from 3.82 to 5.09 after the method application,

Table 3 Students' perceptions on the Method 300

Questions	Answers Likert scale					$n = 30$
	Totally agree (5)	Partially agree (4)	I do not know (3)	Partially disagree (2)	Totally disagree (1)	Median (1–5)
The meetings were good opportunities to study	15 (50%)	14 (46.7%)	0	1 (3.3%)	0	4.5
I liked being part of different groups at each evaluation	6 (20%)	16 (53.3%)	2 (6.7%)	5 (16.7%)	1 (3.3%)	4
I got to know the students in my class better because of the methodology	13 (43.3%)	8 (26.7%)	1 (3.3%)	5 (16.7%)	3 (10%)	4
I feel more relaxed to retake the exam after studying with the 300 group	17 (56.7%)	12 (40%)	0	1 (3.3%)	0	5
The 300 methodology should be used in other disciplines	22 (73.3%)	8 (26.7%)	0	0	0	5
Total[a]	73 (48.7%)	58 (38.7%)	3 (2%)	12 (8%)	4 (2.7%)	4.5

[a]Total response per Likert scale item

corresponding to a 33% increase. Likewise, mean grade increased by 40% in an Engineering course after the protocol [12].

Our study results corroborate the contemporary ideas about the educational process: the teacher is not the center of information [4]. We found all low-performing students to show a significant increase in the course grades after the application of the methodology, thus highlighting its efficiency before each student's individual difficulty. This result is in line with the hypothesis of Abela (2009) [13], who postulates that adults (as is the case of Dentistry students) require teaching–learning processes more interactive and outside conventional standards—something presented by the Method 300.

A study conducted with classes with 130 students found the methodology to be very effective [10], as well as another study with a class of 40 Physiotherapy students—similar to ours, conducted with a class of 30 students [12].

The flipped classroom methodology broadens student–teacher interaction not only beyond the university environment but also beyond class time. Many authors have pointed the case-based learning as one of the most successful methods of active learning, for it enables relations between theory and practice, offering students the opportunity to direct their own learning and to work from different perspectives, methods, and approaches, besides developing real argumentation and problem-solving skills [14]. Although numerous authors consider case-based learning as a variant of the problem-based learning (PBL) methodology, PBL provides students with greater independence, being responsible for looking for information to solve the problem and for participating in discussions [6].

Peer-assisted learning (PAL) is a teaching and learning methodology widely used in the medical field [15]. For providing cognitive, psychomotor, and group interaction support, thus enhancing autonomy, self-confidence, and mutual collaboration [17], PAL is beneficial for both tutors and learners [16]. In this model, students share interpersonal qualities that facilitate informal and empathetic communication and exchange ideas and private matters, thus strengthening bonds [18].

In the Method 300, students act as tutors for their peers, whereas the professor is a mediator of knowledge. As not to inhibit students from expressing themselves, professors do not participate directly in the meetings; rather, they train assistants—who speak the same language as students and underwent the same learning process—who will be responsible for listening to and providing feedbacks on the meetings. According to this methodology, the professor is elevated to a more complex condition of mediator [12].

The number of students providing assistance increased by 200% during the second cycle of activities, whereas that of students receiving help decreased 50%. This finding demonstrates that the number of students who should repeat the test decreased after the first cycle, evincing the effectiveness of the methodology and proving that participants studied harder after exposure. However, low-performing students did not obtain significant recovery in the second cycle. As tests applied in both cycles had the same difficulty level, the changes in the performance of students assisted in the second cycle may be due to the lower number of students in this group, thus accounting only for those with more difficulty. Moreover, group leaders may have been decentralized with the increase in the number of high-performing students in the second cycle, which may also have directly affected the performance of students assisted.

A relevant point to be discussed is whether retaking the test would not be causing false improvements in the results of low-performing students. For addressing such issue, we must consider that students obtained a median grade of 3.5 (max 5.5 and min 2) before retaking the test and of 3 (max 6.3 and min 1) after it, indicating that the fact of retaking the assessment by itself does not suffice to justify an improvement in students' performance. Moreover, the existence of students who persisted as low achieving even after the group study and test retake indicates a great gap in their teaching process. An alternative for retaking the test is to use other assessment methods for students to demonstrate the assimilated content, such as seminars, panel discussions, gamified assessment, or use of technologies to create videos or podcasts.

In a study conducted in an Engineering course, the average performance was assessed in the total period rather than in each cycle, showing positive results [12]. In our study, students' performance was assessed using tests, but this could have been done through panel discussions, quizzes, and clinical case discussions. In the current global scenario of the COVID-19 pandemic, Method 300 can be an alternative teaching–learning method, as it enables tutors to use digital platforms for holding online meetings with colleagues to expose content, ask questions, and discuss the subject previously studied.

Besides the theoretical and practical difficulty inherent to courses, anxiety can also be a determining and decisive factor for academic performance [19], often having negative impacts on exams [16, 19, 20]. In our study, students answered a questionnaire on pre-assessment anxiety level before and after Method 300 application, indicating considerably lower levels of perceived anxiety and tension in assessments after the methodology—a result corroborated by another study using the Method 300 [12]. Such a reduction may be due to the fact that students have two chances of performing the test, which allows them to improve their performance depending on the result of the first try. Moreover, students may become an assistant if they improve their learning performance, which may function as a stimulus for them

[21]. It is worth mentioning that the time spent by assistants with the methodology is not seen as a "waste of time," for they must prepare themselves for teaching the content to their peers. With the improvement in grades, students can also use the meeting time to study other subjects or organize debates and group discussions.

We also found a reduction in failure rate after applying the methodology, in line with other studies conducted in different courses [10, 12]. When students fail a subject, they must perform all curricular activities a second time, which is both exhausting and advised against. Failure can also lead to delay in obtaining the diploma, which can make the student demotivated and stressed with the subject in question [22–25].

Most students considered the Method 300 an efficient studying methodology, besides considering that it could be extended to other fields of study. Such an opinion is reflected on the general results of class performance, as overall grades improved.

This study has some limitations. First, participants reported some issues related to affinity, especially regarding the discomfort in being guided by another student from the same academic year. Moreover, students with greater difficulty had no mastery of basic subjects, such as physiology, histology, and pathology, thus impairing their assimilation of the content taught.

Conclusion

The teaching and learning Method 300 showed positive results in the Dentistry course, thus comprising an important resource to be used in higher education and functioning as a viable alternative to traditional teaching models. More cycles must be applied to evaluate the methodology in the long term.

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Declarations

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical approval All procedures performed in these studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was approved by the Human Research Ethics Committee (CEP 2,444,939), Faculty of Dentistry, São Lucas UniSL University Center (Porto Velho, RO).

Informed consent Informed consent was obtained from all individual participants included in this study.

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