

Students' perception to an interactive web-based response system in oral and maxillofacial pathology teaching

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Abstract: This study evaluated dental students' perceptions and adherence to an interactive web-based response system in the teaching of Oral and Maxillofacial Pathology. Between 2018 and 2019, students from a single Brazilian dental school used the Poll Everywhere® app to answer questions on subjects taught during an Oral and Maxillofacial Pathology course. At the end of the academic semester, the students completed a questionnaire containing 10 questions regarding the app's use. The study included 123 students. Regarding the devices used to answer the questions on the app, 117 (95.1%) students used a smartphone and 3 (2.4%) used a laptop. Almost all students (121; 98.4%) agreed that this interactive web-based response system provided the teacher with a better overview of students' understanding and improved their self-assessment of the acquired knowledge of the subjects. Most students (118; 95.9%) preferred classes using this technology and 122 (99.2%) stated that using the app made them feel more engaged in classes. In addition, all students agreed that the app improved student-teacher interactions. Most students (119; 96.7%) considered the digital interactive method more attractive than the conventional teaching approach, and 99 (80.5%) did not have any negative comments regarding the app. In conclusion, the Poll Everywhere® app provides a more dynamic and attractive educational environment for Oral and Maxillofacial Pathology teaching.

Keywords: Dentistry; Education; Educational Technology; Mobile Applications; Pathology, Oral.

Introduction

Evidence indicates that the conventional teaching method, characterized by long lectures without interactivity, reduces students' attention and motivation to assimilate the content presented, ultimately hindering learning. At present, interactive methods are recommended to address this because the use of technology in education has promoted greater engagement between students and teachers.¹

The interactive response system featuring the use of "clickers" has been tested by several colleges to achieve student-centered learning environments.² Clickers are small mobile devices with which students can answer questions (often multiple-choice questions)



using buttons or keys during didactic lectures. This method allows for an assessment of the audience's comprehension of the subject. Answers are received by the software and shown with a bar graph using PowerPoint (Microsoft, Redmond, USA) software. This is followed by a discussion regarding the correct or incorrect answers. This active participation of students promotes greater knowledge apprehension.^{3,4} However, difficulties in using these devices include the cost per student and technical and structural complexities.⁵

Currently, many students carry personal devices, such as smartphones, tablets, and laptops, that allow them to participate in interactive lectures using methods similar to clickers. Technological development has shifted from these click device systems to smartphones and laptops, introducing web-based or app-based answer systems with options of multiple-choice, numerical, and text-based answers.⁵⁻⁷

There are various names for interactive response systems such as personal response systems, cell-phone-based student response systems, audience response systems,⁵⁻⁹ electronic voting systems,¹⁰⁻¹² student polling systems (clickers),⁹ student response systems,¹³ personal response stations, interactive voting systems, class response systems, interactive student response systems, group response systems, and group process support systems.¹⁴ As previously stated, the two main types of interactive response systems are clickers and web-based response systems, distinguished only by the devices used, i.e., voting-portable and mobile devices, respectively.¹⁵

A previous study compared the use of clickers in an interactive app-based response system.⁷ The functioning of this app is similar to that of an interactive response system. The student does not need to buy a separate device but needs to carry a smartphone, laptop, or tablet to answer questions. Professors can ask multiple-choice or open-ended questions that are shown either on a screen or in a web browser on the participants' devices. After submitting their responses, the students can immediately see whether they have responded correctly. Responses can also be presented directly in a PowerPoint (Microsoft, Redmond, USA) slideshow.

In this study, it was evident that using the response app overcame challenges and was satisfactory as a tool for promoting engagement between teachers and students.⁷ Another survey evidenced that the audience response system (clickers) is well-accepted among dental students and significantly increases their participation in oral and maxillofacial radiology lectures.¹⁶

Technology is creating new ways for students and educators to engage in interactive classrooms. By using web tools, students can use their mobile devices for free, thus improving the ease and practice of active learning. However, no studies have assessed an interactive web-based response system for teaching oral pathology. Therefore, in this study, dental students' perceptions and adherence to a web-based response system in Oral and Maxillofacial Pathology teaching were examined.

Methodology

This cross-sectional study was performed at a Brazilian dental school. It was approved by the local Research Ethics Committee (protocol number: 97769218.4.0000.5208) and conducted in accordance with the Declaration of Helsinki.

The sample for this study comprised second-year students in the dentistry program who were enrolled in the Oral and Maxillofacial Pathology course between August 2018 and December 2019. The subjects covered in this course have both theoretical and practical components. Study participants used web-based response system technology via the Poll Everywhere® app for mobile or portable devices (Poll Everywhere, San Francisco, USA) during regular academic activities throughout the semester. The students were instructed to download the app for free on their devices (smartphones, laptops, or tablets). Subsequently, they could interact and answer questions in the Oral and Maxillofacial Pathology classes. Using the Poll Everywhere® app, questions were shown to students on a PowerPoint slideshow (Microsoft, Redmond, USA) during teaching-learning activities. The questions aimed to provide the teacher with an overview of students' understanding of the subjects being discussed.

For each topic addressed, students were asked to answer interactive questions (multiple-choice or multimedia-based questions) individually. Next, the percentage of answers for each alternative was presented in graphs, and the correct responses (and why they were correct) were discussed (Figure 1). The questions were knowledge-based or scenario-type involving clinical cases. Clinical, radiographic, or microscopic images were used, which required students to reason (Figure 2). The time allocated for each question was flexible, but did not exceed five minutes.

At the end of the semester, students who participated in the web-based response system were invited to complete a questionnaire to assess the method. Only students who voluntarily agreed to participate in the study and completed the informed consent form were included. The questionnaire contained 10 objective questions regarding students' perceptions and use of Poll Everywhere® during teaching activities. Additionally, students' perceptions of the interactive teaching method were compared

with their perceptions of the conventional approach. The assessment instrument was adapted from Morrell and Joyce.⁶

The collected data were tabulated in a spreadsheet using Microsoft Excel (Microsoft, Redmond, USA), and the absolute and relative data distributions measured for each variable were observed through descriptive analyses.

Results

In the study, 123 students consented to participate. Of the total participants, 91 (74%) were female and 32 (26%) were male. Moreover, 117 (95.0%) used a smartphone to answer the questions on Poll Everywhere®, 3 (2.5%) used a laptop, and 3 (2.5%) did not report the device used. Concerning previous experience with interactive technology, 93 (75.6%) students stated that they had already used it in didactic lectures before this study. Most students (n = 121; 98.4%) agreed that the app helped improve their understanding of the subjects taught compared

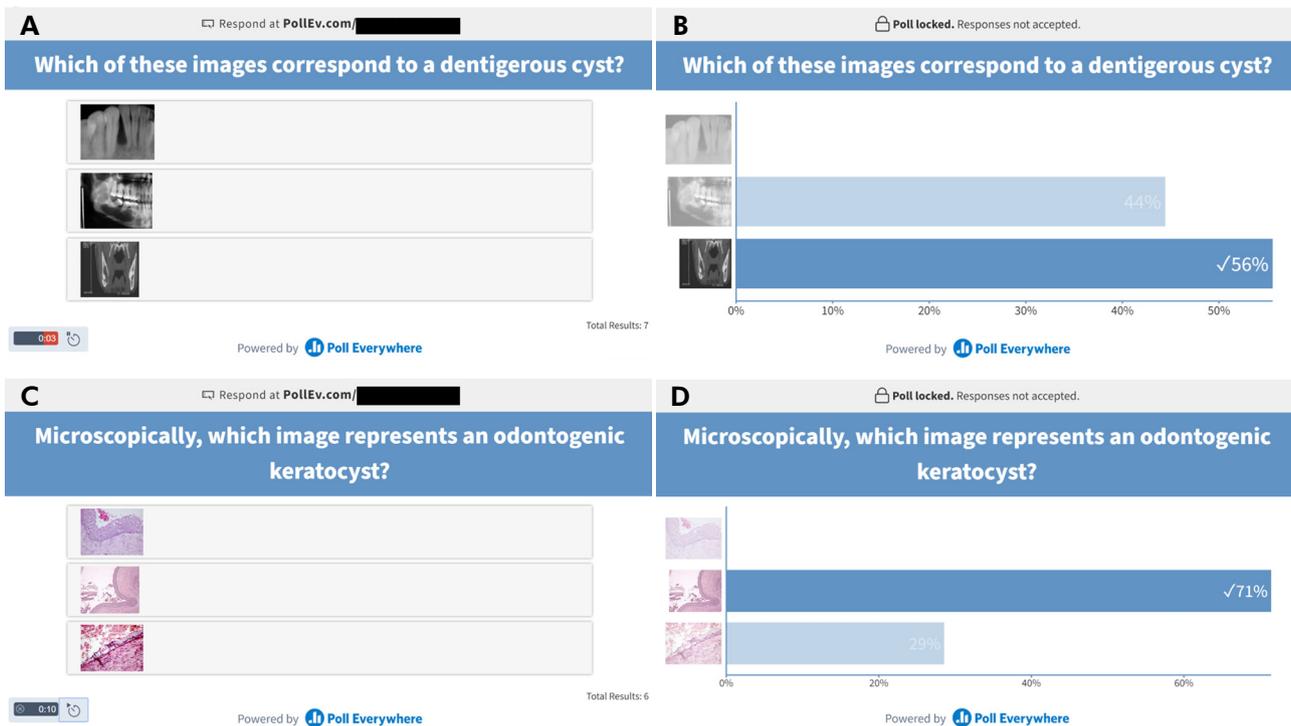


Figure 1. A, C - Examples of how questions are presented in PowerPoint during class using Poll Everywhere. B, D - After the students' answers, percentage of responses for each alternative represented in graphs and presented in PowerPoint.

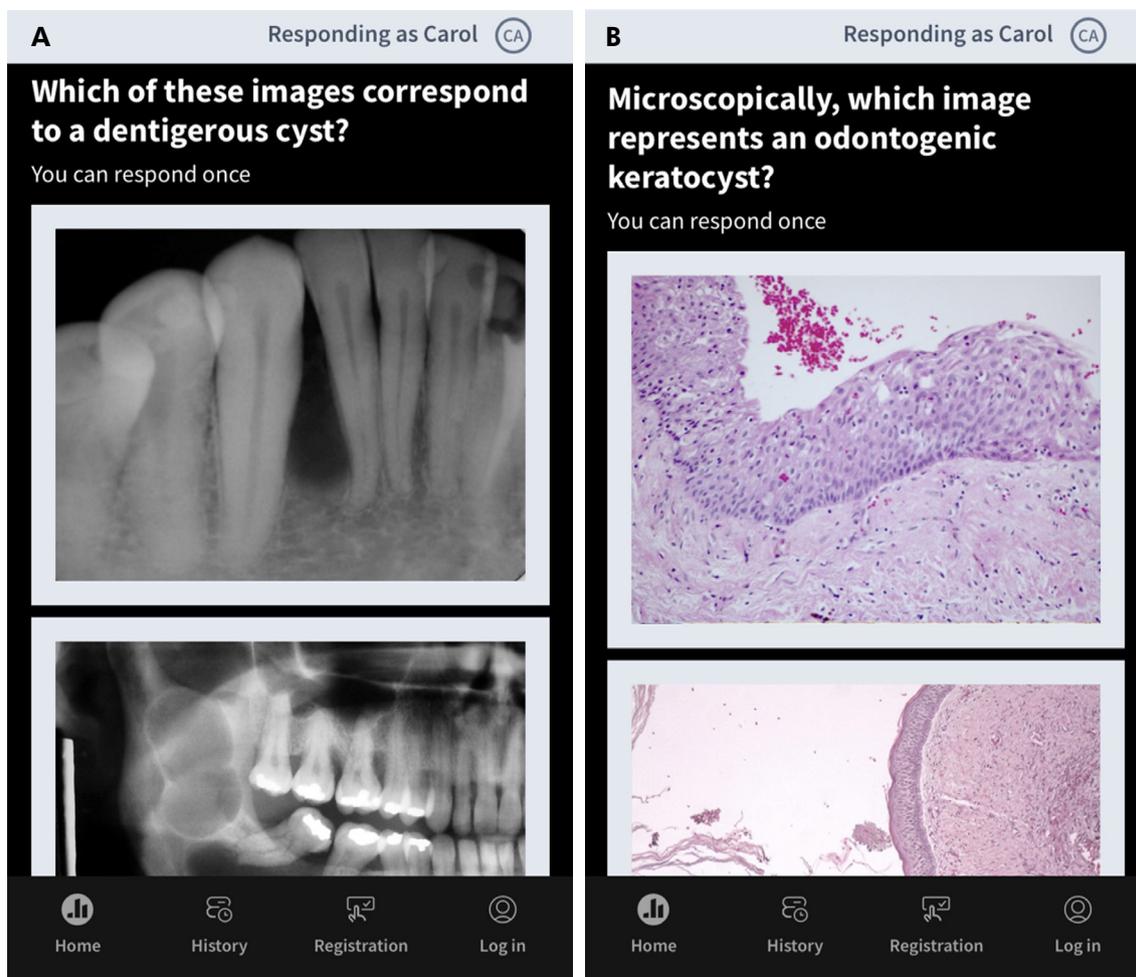


Figure 2. Questions presented to students on their mobile phones, using the Poll Everywhere app. The student must click on the figure corresponding to the correct answer. A - Question presented in Figure 1A. B - Question presented in Figure 1C.

with the conventional teaching method. Accordingly, 122 (99.2%) participants stated that using this app as an educational tool made them feel more engaged during classes and 121 (98.4%) agreed that this interactive method provided the teacher with a better overview of students' understanding of the subjects taught. In addition, 121 (98.4%) students stated that the questions asked during class via the app aided in their acquisition of a genuine understanding of the subject. In addition, 118 (95.9%) participants preferred an interactive teaching approach, while 5 (4.1%) reported that they preferred the conventional teaching method (Table).

All participating students agreed that this tool could improve student-teacher interactions, and 119 (96.7%) responded that this interactive method was

more enjoyable and interesting than the conventional teaching approach. Most participants (n = 99; 80.5%) did not have any negative comments related to the use of the Poll Everywhere® app, although 21 (17.1%) raised some negative points and 3 (2.4%) did not answer this question. Among the negative points mentioned by the students, 2 (1.6%) cited the short time given to answer the questions, 4 (3.3%) pointed out that the app showed the percentage of responses before everyone had answered, and (3.3%) pointed to the possibility of changing the answer selected. Furthermore, 6 (4.9%) students stated that the internet connection could be a limitation while using the app, 1 (0.8%) indicated that excessive use could make it uninteresting, 1 student (0.8%) pointed out that it was possible to be distracted, and 1 (0.8%)

Table. Students' perceptions of web-based interactive teaching method.

Questions	Yes		No		NA*		Total	
	n	%	No	%	NA*	%	n	%
Did the Poll Everywhere® app as an interactive method help you to improve the understanding of the taught subjects compared to the conventional teaching method?	121	98.4	2	1.6	-	-	123	100
On using the Poll Everywhere® app as educational tool, did you feel more engaged during classes?	122	99.2	1	0.8	-	-	123	100
Do you think using this interactive method provides the teacher with a better overview of the students' understanding of the taught subjects?	121	98.4	1	0.8	1	0.8	123	100
Did the questions asked during the class by the app help you to realize your real understanding of the taught subject?	121	98.4	1	0.8	1	0.8	123	100
Do you find that the use of this tool helps student-teacher interaction?	123	100	-	-	-	-	123	100
Do you find that this teaching method is more enjoyable and interesting than conventional teaching method?	119	96.7	4	3.3	-	-	123	100

*Participants did not respond.

stated that the need to use an electronic device could be a barrier for students who did not have one. Additionally, 1 (0.8%) participant suggested that this technology could be used for other subjects in the dentistry program, and another (0.8%) participant stated that the interaction proposed by the app was not interesting (Table).

Discussion

The Poll Everywhere® application is an interactive response system that is easy to use and offers free access for up to 40 participants. The host can create multiple-choice, open-ended, and multimedia-based questions. Participants can answer questions by short message service (SMS) text messages or web answers via the host voting page or a private link. The responses can be displayed in a live poll through the website or directly in a PowerPoint slideshow as graphs,^{9,17} as was done in this study. Poll Everywhere® was chosen because it is a practical, easy-to-use, and simple technology. This app can also ensure the anonymity of users and provide real-time feedback by displaying answers to questions asked by the audience. Moreover, this app allows for oral pathology content-based challenges among the student groups.

The findings of this study suggest that the introduction of a web-based response system has a positive effect on students' perceptions. Although

several studies have analyzed this type of response system, including the Poll Everywhere® app,^{7-9,17-19} no studies have evaluated this technology in the teaching of oral pathology. All relevant studies have reported the benefits of using this tool in the learning process, such as an increased resolution of doubts about a topic, thus ensuring more satisfactory results in academic performance. Furthermore, the introduction of new and active learning methods in didactic lectures stimulates critical thinking and enhances learning.¹ However, the implementation of new pedagogical strategies should be managed correctly, as incorrect implementation may be ineffective in educational activities. Web-based response systems should be complementary to the pedagogical approach but not the main teaching strategy. The study findings indicated that students preferred classes with interactive methods that complement teaching.⁶ In addition, the teacher should provide sufficient time for the interactive session and discussion during a lecture. The time provided to answer and discuss a question usually varies from two to five minutes, depending on the complexity of the question. This time interval was used in the present study. Ensuring sufficient wireless connectivity for efficient operation is an important aspect. With these and other requirements, interactive tools such as Poll Everywhere® can contribute to more active learning and student-teacher interactions.¹¹

A study determined that most students used smartphones to participate in activities with web-based response systems⁶; similar to findings of the current study. Currently, several forms of educational technologies are available in the teaching environment, given teachers' need for more interactive classrooms.²⁰ This reality seems to support the findings of this study, as most students stated that they had already used interactive technology in other didactic lectures prior to participating in this study.

The findings of this study also indicated that the use of interactive teaching resources improved students' understanding of the subject taught compared with the conventional teaching method. Datta et al.¹ observed that the proper use of interactive tools makes conventional didactic lectures more enjoyable. The disadvantages of a class without interaction include a lack of attention, non-development of critical thinking, and limitations to students' self-evaluations. Furthermore, there is no substantial support for the capacity of interactive response systems to aid the learning process. Several hypotheses justify this mechanism: a) the novelty effect, which increases students' attention; b) the testing effect, as performing exercises induces students to access long-term memory, thus improving the probability of further memorization; c) the adjunct-question effect, which refers to questions interspersed immediately after reading a written text—similar to the active methodology of answering questions after learning a concept—improves students' performance; d) the feedback intervention effect, which promotes students' self-evaluations through their successes and failures and discussions of the topic; and e) the (self-)explanation effect, in terms of answering questions and participating in the discussion, can modify students' knowledge by adding more detailed information.²¹

During didactic activity, in which listeners are passive, their concentration decreases after 20 minutes. Thus, it is recommended that active methodologies be used to keep the audience attentive and to increase student performance. Web-based response systems have been relevant tools for increasing listeners' attention as they can improve the interaction between them and the speaker. In

addition, these systems measure the understanding of the subject being discussed.¹² In the current study, almost all students felt more engaged during classes, suggesting a greater concentration of students in teaching activities. A study performed in a UK dental school with fourth-year undergraduate orthodontic students showed that when an interactive methodology was used, students performed and retained subject knowledge better. Additionally, students were more attentive and participated easily in didactic activities.²² In the present survey, most participants pointed out that the app provided the teacher with a better overview of students' understanding of the subjects. This encouraged a more complete discussion of the subjects, thereby resolving doubts. All students stated that the use of the app facilitated interactions between the students and teachers. Similar feedback was observed in a study involving health, science, and engineering students who agreed that teachers should continue to use active methods in classes.²³

Most students agreed that the questions used in the app aided in recognizing doubts in their understanding of the content taught by the professor. Comparable results were found in a study involving a group of residents in a pediatric intensive care unit who assessed their educational experiences with an interactive app.²⁴ All participants reported satisfaction with the web-based response system. Residents stated that they learned better because they identified topics not yet understood and could improve their knowledge.²⁴ Particularly during the COVID-19 pandemic, with the interruption of face-to-face classroom educational activities worldwide, including in dental schools,²⁵ the use of a web-based response may be an important tool to improve the engagement of dental students during e-learning.

Despite the didactic benefits of this technology, users have also reported some disadvantages. Using personal mobile devices, possibly using extensive data on mobile internet plans, discharging battery reserves, and experiencing problems with internet connectivity are among the disadvantages reported by students. In addition, students reported that using mobile devices made it easier for them to

be distracted for other purposes such as checking social media, emails, and websites. However, despite these drawbacks, the perceived benefits of using web-based response systems were greater than any possible distractions.⁶ Particularly in this study, approximately 17.1% of students pointed out some disadvantages in using the app, mainly the need for an internet connection and the use of personal electronic devices. According to official statistics, 93.2% of households in Brazil have mobile phones, 41.7% have microcomputers/laptops, and 12.5% have tablets. Moreover, 99.2% of internet use is via smartphones.²⁶ Currently, most universities provide free internet access, enabling the use of web-based response systems at no additional cost for students,¹⁴ including the system assessed in this study.

Despite the strengths of this study, some limitations must be considered: a) The non-probabilistic nature of the sample may over- or under-report the students' real perceptions of this learning tool, although almost all students pointed to positive attributes; b) dental schools have different teaching methods; and c) cultural and socioeconomic differences around the world may interfere with students' perceptions of several learning tools, including web-based response systems. Therefore, further global studies involving

different dental schools are required to assess this issue more extensively. In addition, further studies should propose methods to assess students' academic achievement using this technology, compared with traditional teaching methods.

This study shows the positive impact of a web-based response system on three aspects: effectiveness, students' perception, and adherence to the learning tool. The findings suggest that technological innovations such as web-based response systems can assist in dental education and provide changes to conventional classroom teaching methods, thereby contributing to more effective learning, including in oral pathology subjects. Further studies are needed to evaluate other software and apps in other dental specialties to ensure safe and effective introduction to this interactive form of teaching. The findings will help educators identify the best form of student-centered teaching.

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