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An AI-based e-learning tool to improve endodontic diagnostics in undergraduate students

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1 | PROBLEM

Undergraduate students often lack experience in diagnosing dental pain, especially in those cases with pulpal involvement and a need for endodontic treatment. Not all university dental clinics provide participation of the students in providing emergency dental services. During their undergraduate dental education, the students have to be provided with clinical teaching and support how to diagnose and prepare treatment plans for emergency and/or elective dental treatment. Thus, after graduation young dentists would not face challenges in diagnosing the location and cause of the odontogenic pain.

2 | SOLUTION

Developing an e-learning tool utilizing the Generative Pre-trained Transformer 4 (GPT-4) Model (OpenAI) is to enable students to undergo a proper training on how to diagnose diseases of endodontic origin in realistic conversational setting on virtual patients. Unlike previous linear conversational approaches,[1] the GPT-4 model allows for advanced, life-like conversations. International Nursing Association for Clinical Simulation and Learning standards of best practice simulation design were applied.[2]

The practice protocol for the students is:

1. Students receive a briefing within the e-learning tool including an introduction to the setting, a program overview, and a guide for a structured diagnostic approach. Afterward, they will engage in diagnosing a virtual patient.

2. Students are required to conduct the diagnostic process, fostering a profound immersion in the topic and thereby cultivating the development of a structured personal approach of diagnosing the cause of dental pain. They will have the opportunity to work simultaneously on their communicative skills. To achieve the necessary realism, each case provides a patient's history and all essential parameters required for a final diagnosis. These include pain history, medical history, clinical presentation, clinical tests, and radiographic findings (Figures 1 and 2).

3. This proposed approach also presents the opportunity for students to learn how to educate their patients on their condition and the proposed treatment plan in order to obtain informed consent for dental treatment. This prompts the student to apply their theoretical knowledge in a reality-based setting and critically examine their own potential knowledge gaps (Figure 3).

4. The completed conversation with the patient is followed by a debriefing, providing information on the correct diagnosis and an exemplary annotated chat protocol conducted by an experienced clinician. In this way, observational learning is facilitated and enhanced in relation to the students' structured diagnostic and communication approach.

FIGURE 1   Exemplary plot of a conversational opening in endodontic diagnostics.

FIGURE 2   Exemplary plot of a conversation to evaluate the quality of dental pain.

3 | RESULTS

The preliminary pilot testing with a selected group of students and teachers has yielded promising results, suggesting this method as a viable means of practicing diagnostic skills in a secure environment. However, the significant effort required to construct patient cases cannot be understated, particularly due to the difficulty in obtaining clinical images and radiographs because of copyright restrictions. Furthermore, careful planning and iterative refining were necessary to obtain reliable outputs from the artificial intelligence model. To mitigate
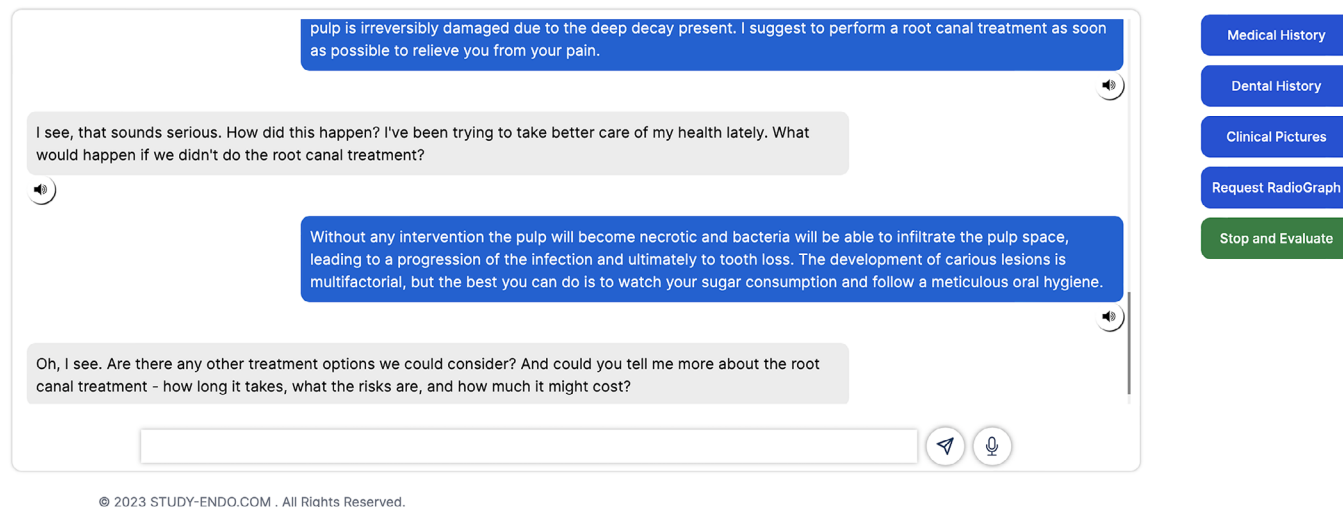
FIGURE 3 Exemplary plot of a conversational informing the patient about treatment options to obtain an informed consent for dental treatment.

the unwanted behavioral characteristics of GPT models, such as hallucinations, a detailed and comprehensive case design was needed, along with restrictive guidelines for the GPT model. Thus, the model was confined to answer only database-solvable queries and otherwise it would have responded only in an evasive manner.

A future pilot study is planned with a more extensive group of undergraduate students to appraise the effectiveness of this program. The objective is to gather additional insights into how it is perceived by a larger student population, which will later help identify areas for further enhancements.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

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