

From Description to Diagnosis: Leveraging GenAI as a Tutor for Dental Radiographic Interpretation

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Background and Pedagogical Opportunity Addressed:

In the OMS3100 Oral & Maxillofacial Medicine, Pathology & Radiology course, students are expected to:

1. Identify and describe abnormalities on dental X-rays
2. Suggest a list of likely lesions (*differential diagnosis*) and explain their reasoning for their answers

Key Challenge:

During a tutorial (26 students/group), students take turns presenting cases and explaining their rationale. However, in 2 hours, **there isn't enough time for every student to present for each case**, and the instructor cannot give detailed individual feedback to everyone.

Pedagogical Opportunity Addressed:

In collaboration with AICET, GenAI was employed through the development of a chatbot tutor, to help students gain repeated practice in a more structured way before class, and to receive individualised feedback.

Implementation details:

1. Chatbot development

LLM was configured as a structured tutor using 5 cases, guiding students stepwise through a consistent three-stage structure: (i) description of lesion, (ii) categorisation, and (iii) differential diagnosis with rationale, using a "demanding Socratic" approach.

2. Pre-class homework assignment

The chatbot was deployed via the SchoAlstic platform. Completion of all 5 cases prior to tutorials was mandatory.

3. Chat transcript audits (prior to tutorial)

Before meeting the students for class, selected transcripts were audited to check for the quality of student responses and to monitor for issues with the chatbot behaviour e.g. factual inaccuracies or hallucinations, excessive or inadequate strictness.

4. In-person tutorial

Cases were discussed in class, with an emphasis on any queries that the students had after interacting with the chatbot. This time was also used to convey additional teaching points that could not be communicated through the chatbot (e.g. elaboration on differential diagnoses which I would or would not accept, and why), and any misconceptions or bot errors that I picked up during my audit (e.g. incorrect statements about lesions which the bot did not correct).

5. Post-tutorial: Analysis of the chat transcripts

We are planning on reviewing the students' chat transcripts and feedback in a more comprehensive manner and will be gathering data on both student and bot performance.

6. Bot refinement

Based on the above analysis, we plan to refine the current prompts for the next student cohort.

Reflections:

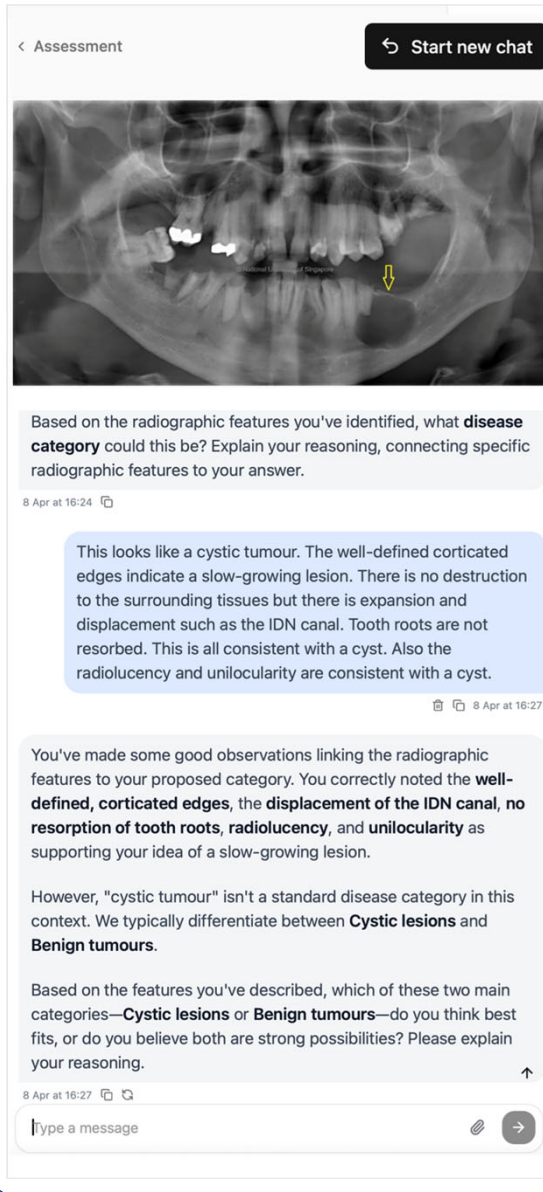
- Prompt engineering involves a steep learning curve; collaboration with experienced colleagues (e.g., NUS AICET) was critical.
- The chatbot also requires multiple rounds of rigorous pre-implementation testing, supported by sufficient testers.
- Instructions for the chatbot assignment were delivered via email. However, an in-class briefing would have been more effective to demonstrate proper usage and highlight limitations such as hallucinations, over-agreeableness, and excessive strictness, and to emphasize appropriate usage to the students (i.e. using professional language, not directly asking the chatbot to provide them with answers).
- Although the limitations of GenAI were discussed during tutorials, introducing them earlier would have better prepared students to critically evaluate the chatbot's responses, and to cross-reference them against reliable sources, such as lecture notes and textbooks.
- This would allow students to engage with the chatbot more effectively in their learning process

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Sample of a chatbot tutor conversation:

Chatbot text is in grey and student is in blue



The screenshot shows a chat interface titled "Assessment" with a "Start new chat" button. It features a dental radiograph of a maxillary arch with a yellow arrow pointing to a lesion in the right maxillary sinus. The chat history includes:

- Chatbot (grey):** "Based on the radiographic features you've identified, what **disease category** could this be? Explain your reasoning, connecting specific radiographic features to your answer." (8 Apr at 16:24)
- Student (blue):** "This looks like a cystic tumour. The well-defined corticated edges indicate a slow-growing lesion. There is no destruction to the surrounding tissues but there is expansion and displacement such as the IDN canal. Tooth roots are not resorbed. This is all consistent with a cyst. Also the radiolucency and unilocularity are consistent with a cyst." (8 Apr at 16:24)
- Chatbot (grey):** "You've made some good observations linking the radiographic features to your proposed category. You correctly noted the **well-defined, corticated edges, the displacement of the IDN canal, no resorption of tooth roots, radiolucency, and unilocularity** as supporting your idea of a slow-growing lesion." (8 Apr at 16:27)
- Chatbot (grey):** "However, 'cystic tumour' isn't a standard disease category in this context. We typically differentiate between **Cystic lesions** and **Benign tumours**." (8 Apr at 16:27)
- Chatbot (grey):** "Based on the features you've described, which of these two main categories—**Cystic lesions** or **Benign tumours**—do you think best fits, or do you believe both are strong possibilities? Please explain your reasoning." (8 Apr at 16:27)

The interface includes a text input field at the bottom with a placeholder "Type a message" and a send button.